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ARTICLES

EFFECTIVENESS OF INSECTICIDES ON GRANULAR CLAY CARRIERS AGAINST MOSQUITO LARVAE [1]

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Insecticides incorporated with granular carriers have been highly successful as larvicides against mosquitoes and sand flies, and have been particularly useful when the vegetative cover was too dense for penetration by sprays and dusts (Whitehead 1951, Keller *et al.* 1954a and b, and Labrecque and Goulding 1954). To determine whether the size or the composition of the granules has any effect on the efficiency of the finished material, various clays impregnated with insecticides were tested in the laboratory and in the field against larvae of *Anopheles quadrimaculatus* Say, *A. crucians* Wied., and *Aedes aegypti* (L.).

Laboratory Tests.—In the laboratory tests granules were dropped into quart jars containing 900 ml. of distilled water, 25 fourth-instar larvae were added, and mortality counts were taken after 24 and 48 hours. Unless otherwise stated, the granules were made by the authors by impregnating the carriers with acetone solutions of the insecticides.

Tests were conducted against larvae of *Anopheles quadrimaculatus* to determine the relative effectiveness of two attapulgite products (A and B),[2] bentonite,[3] diatomite,[4] and pyrophyllite [5] as granular carriers of dieldrin. The carriers were impregnated with 1 percent of dieldrin, dried, and separated by sifting into mesh sizes of 5/10, 10/20, 20/30, 30/40, 40/60, 60/80, 80/100, and greater than 100. As the pyrophyllite was a finely ground powder, a small quantity of thin starch paste was added to form granules. The granules were tested at concentrations of 0.01, 0.1, and 1 p.p.m. of the insecticide, and each test was replicated 2 to 4 times. Mortality counts were made after 48 hours.

Based on an average for all tests run with each carrier, the diatomite and pyrophyllite preparations appeared to be the best of the group at the two lower concentrations. They produced kills of 87 and 93 percent at 0.1 p.p.m. and 48 and 60 percent at 0.01 p.p.m., compared with 65 to 77 percent at 0.1 p.p.m. and 27 to 38 percent at 0.01 p.p.m. for the other carriers. At a concentration of 1 p.p.m. the mortalities obtained with the various granules averaged 85 percent for the B sample of attapulgite and between 95 and 98 percent for the other materials. No optimum mesh size was indicated.

In the tests to compare their effectiveness against *Anopheles quadrimaculatus* and *Aedes aegypti* larvae, only the 40/60-mesh granules were used and the concentration of dieldrin was 0.1 p.p.m. The results are given in table 1. *A. quadrimaculatus* larvae were more susceptible to most of the formulations than *aegypti*. Diatomite and pyrophyllite were again the most effective carriers against *quadrimaculatus*, and diatomite was the most effective carrier against *aegypti*.

Since mixtures of attapulgite and bentonite granules are frequently used as carriers for dieldrin, tests were conducted to determine whether an optimum mixture of these carriers could be selected. The

[1] This work was conducted at the Orlando, Fla., laboratory of the Entomology Research Branch under funds allotted to the Branch by the Department of the Army.

[2] Florex S (A) and Attaclay A (B).

[3] Volclay.

[4] Pyrax ABB.

[5] Celite 408.

TABLE 1.—Relative susceptibility of *Anopheles quadrimaculatus* and *Aedes aegypti* larvae to 1-percent dieldrin granules prepared with various carriers. (2 replications; 0.1 p.p.m. of dieldrin.)

Carrier	Percent mortality after 48 hours	
	quadrimaculatus	*aegypti*
Attapulgite A	60	36
Attapulgite B	52	34
Bentonite	64	38
Diatomite	76	76
Pyrophyllite	96	28

30/60-mesh granules were mixed in various proportions to obtain attapulgite:bentonite ratios of 0:100, 25:75, 40:60, 50:50, 60:40, 75:25, and 100:0. Each combination was impregnated with 1 percent of dieldrin. Two tests were conducted with each formulation against larvae of *quadrimaculatus* at a concentration of 0.1 p.p.m. The 48-hour mortalities ranged from 60 to 84 percent, but the ratio of attapulgite to bentonite had no apparent influence on the effectiveness of the granules.

Tests were made with 30/60-mesh granules of the 25:75 attapulgite-bentonite mixture impregnated with 1 percent of dieldrin to determine whether the toxicant diffused uniformly through the water. The granules were added, without stirring, to 900 ml. of water in a quart jar to obtain a concentration of 0.1 p.p.m. of dieldrin. The following day two 400-ml. portions were siphoned from the top of the jar, without disturbing the portion remaining in the bottom of the jar, and *quadrimaculatus* larvae were exposed in each 400-ml. portion. After 24 hours the mortalities were 22 and 26 percent in the two portions, and after 48 hours 44 percent in both, indicating equal diffusion of the toxicant.

Tests against *quadrimaculatus* larvae were made with attapulgite granules impregnated with 1 percent of dieldrin in

TABLE 2.—Toxicity of 25 granular larvicides against fourth-instar larvae of *Anopheles quadrimaculatus*. (Average of 2 tests.)

Larvicide	Percent mortality after 48 hours		
	0.1 p.p.m.	0.01 p.p.m.	0.001 p.p.m.
Parathion	100	98	88
EPN	100	96	36
Am. Cyanamid 4124	100	76	—
TDE	100	74	—
Am. Cyanamid 12008	100	60	—
Bayer 21/199	100	56	—
Am. Cyanamid 12009	100	54	—
Diazinon	100	28	—
Fluorine analog of DDT	96	26	—
DDVP	98	6	—
Ethyl homolog of DDVP	100	4	—
Bromine analog of DDT	84	—	—
Endrin	78	—	—
O,O-Diethyl *N*-carbethoxymethyl-phosphoramidothioate	76	—	—
Lindane	74	—	—
Dieldrin	64	—	—
Chlordane	60	—	—
Toxaphene	54	—	—
Methoxychlor	52	—	—
Propyl homolog of DDVP	50	—	—
o,p'–DDT	48	—	—
Heptachlor	44	—	—
Chlorinated isobornyl phenyl sulfone (66% chlorine)	40	—	—
Chlordane (refined)	34	—	—
Aldrin	24	—	—

various solvents of low and high volatility. The highly volatile solvents—carbon tetrachloride, heptane, acetone, benzene, and xylene—were used at the rate of 20 percent of the total weight of the ingredients, and those of low volatility—fuel oil, mineral spirits, and kerosene—at 35 percent. All the solvents were satisfactory and none appeared to be superior to the others.

Tests against *quadrimaculatus* larvae were conducted with 25 insecticides, all of high larvicidal activity, to evaluate their effectiveness in granular formulations. The results with attapulgite (Attaclay AA RVM) granules containing 1 percent of the toxicant applied at various concentrations are given in table 2. Parathion and EPN at 0.01 p.p.m. and nine compounds at 0.1 p.p.m. were highly effective. The remainder were less than 85 percent effective at 0.1 p.p.m.

Field Tests.—The 11 granular larvicides that proved to be the most effective in the laboratory tests were further tested in roadside ditches infested with larvae of *Anopheles crucians* and *quadrimaculatus*. The water was covered with water hyacinth (*Eichornia crassipes*) and waterlettuce (*Pistia stratiotes*), and *crucians* was the dominant species. Attapulgite (Attaclay AA RVM) granules containing 1 percent of the insecticide were applied to 10- by 20-foot plots at various dosages. The control was determined by 10 dipper samplings taken in each plot before treatment and after 24 hours. The results are presented in table 3. Parathion, EPN, and Bayer 21/199 were highly effective at 0.01 pound per acre, and all the insecticides except DDVP and its ethyl homolog were highly effective at 0.1 pound per acre.

Summary.—Laboratory tests against fourth-instar larvae of *Anopheles quadrimaculatus* Say with 1 percent dieldrin granules indicated that pyrophyllite B and diatomite were slightly more effective carriers than attapulgite A or bentonite, but all the carriers made satisfactory granules. Granules of mesh sizes ranging from 5/10 to >100 were all equally effective. Granules made with highly volatile solvents such as carbon tetrachloride and xylene and granules made with solvents of low volatility such as fuel oil were equally effective. Dieldrin diffused evenly through quart jars of water treated with granules. Larvae of *Aedes aegypti* (L.) were more resistant than larvae of *Anopheles quadrimaculatus* to dieldrin granules. Parathion and EPN were the most effective of 25 granular larvicides in laboratory tests against *quadrimaculatus*. Parathion, EPN, and Bayer 21/199 were the most effective in field tests against *quadrimaculatus* and *Anopheles crucians* (Wied.).

TABLE 3.—Effectiveness of various granular larvicides against larvae of *Anopheles quadrimaculatus* and *A. crucians* in roadside ditches.

Insecticide	Percent reduction in 24 hours at indicated dosage per acre		
	0.1 pound	0.01 pound	0.001 pound
Parathion	100	88	53
EPN	97	99	27
Bayer 21/199	99	98	21
TDE	98	73	—
Fluorine analog of DDT	97	79	—
Diazinon	99	64	—
Am. Cyanamid 4124	97	57	—
Am. Cyanamid 12008	92	82	—
Am. Cyanamid 12009	94	83	—
DDVP	66	42	—
Ethyl homolog of DDVP	62	72	—

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A CHECK LIST OF THE MOSQUITOES (CULICINAE) OF NORTH AMERICA (DIPTERA: CULICIDAE)

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INTRODUCTION—Many additions to and changes in the list of North American mosquitoes have been made in the ten years since Dr. Robert Matheson's "Handbook of the Mosquitoes of North America" was published in 1944. Therefore, a resolution was made at the March 1954 meetings of the American Mosquito Control Association in Atlantic City, N. J., proposing that a check list of the North American mosquitoes be prepared and published in *Mosquito News*. In the interests of economy of space, references to new species described, new synonymy proposed, or previously described species added to the North American mosquito fauna have been listed only where these additions or changes were not included in the 1944 edition of Dr. Matheson's book.

These changes may be summarized briefly as follows: *Anopheles earlei* Vargas is recognized as a valid species. The generic name *Megarhinus* is changed to *Toxorhynchites,* and the tribe, from Megarhinini to Toxorhynchitini following Stone (1948). The genus *Toxorhynchites* in the United States includes one species with two subspecies, *rutilus rutilus* (Coquillett) and *rutilus septentrionalis* (Dyar and Knab), following Jenkins (1949). *Wyeomyia haynei* is described as new by Dodge in 1947. *Uranotaenia syntheta* Dyar and Shannon is listed as a subspecies of *Uranotaenia anhydor* Dyar.

In the large genus *Aedes,* two subgenera not listed in Matheson are recognized: the subgenus *Taeniorhynchus* following Ross (1947) including *mitchellae* (Dyar), *nigromaculis* (Ludlow), *sollicitans* (Walker) and *taeniorhynchus* (Wiedemann); and the subgenus *Feltianus* Martini (1930) for two species *trichurus* (Dyar) and *bicristatus* Thurman and Winkler, which have more than one pair of hair tufts on the larval air tube and very short claspette filaments with transverse wrinklings in the male genitalia. *Aedes zoosophus* Dyar and Knab is an earlier name than *alleni* Turner, *decticus* Howard, Dyar and Knab is an earlier name than *pseudodiantaeus* Smith, *impiger* (Walker) is an earlier name for the species known for many years as *nearcticus* Dyar, *nigripes* (Zetterstedt) is a more appropriate name than *alpinus* Linnaeus, and *thelcter* Dyar is an earlier name than *keyensis* Buren. After examining the types in the British Museum, Vockeroth (1954) decided that *impiger* Walker was identical with *nearcticus* Dyar and that a new name *implicatus* Vockeroth was needed for *impiger* of Dyar (1928), Matheson (1944) and others. He found that the type of *implacabilis* Walker was identical with *punctor* Kirby and therefore revived the name *abserratus* (Felt and Young) for the species known as *implacabilis* by many authors. Knight (1951) separated *punctodes* Dyar as a distinct species in the *punctor* group, and Vockeroth (1954) described a new species *rempeli. Aedes spencerii* (Theobald) is the correct name for both *spencerii* (Theobald) and *idahoensis* (Theobald). Similarly, the name *sticticus* (Meigen) appears to be the correct name for both *sticticus* and *lateralis* in North America. *Aedes tortilis* (Theobald) is added to the North American fauna on the basis of the Key West record of Staebler and Buren (1946) and additional records from the Florida Keys. Smith (1952) has described and correctly associated the stages of *diantaeus* Howard, Dyar and Knab and a closely allied new species *pseudodiantaeus* Smith, here placed as a synonym of *decticus* Howard, Dyar, and Knab.

In the large genus *Culex* subgenus *Culex, chidesteri* Dyar has been found in Texas by Joyce (1948), the *pipiens* com-

plex has been divided into three subspecies: *pipiens molestus* Forskal, *pipiens pipiens* Linnaeus, and *pipiens quinquefasciatus* Say following Rozeboom and Gilford (1954), *thriambus* Dyar has been separated from *stigmatosoma* by Galindo and Kelley (1943), and *virgultus* (Theobald) has been recognized as an earlier name than *declarator* Dyar and Knab by Lane (1951 and 1953). In the subgenus *Neoculex,* Bohart (1948) has used larval and male characters to divide the species previously known as *apicalis* Adams. *Culex (Neoculex) apicalis* Adams is restricted to southwestern United States, the name *territans* Walker is revived for the species previously known as *apicalis* in eastern and northwestern North America, a new species *arizonensis* Bohart is described from Arizona and California, and a second new species *reevesi* Bohart is described which Brookman and Reeves (1950) believe is different from *reevesi* Wirth. They therefore have renamed *reevesi* Bohart as *boharti* Brookman and Reeves. The mosquitoes in the subgenus *Melanoconion* have been studied intensively in recent years, Rozeboom and Komp (1950) making a detailed study of the males, and Foote (1954) of the larvae. Foote has revived the subgenus *Mochlostyrax* for some of the species formerly contained in the subgenus *Melanoconion* including the North American species *pilosus* (Dyar and Knab). The larva of *anips* Dyar was described by Brookman and Reeves (1953), *iolambdis* Dyar was reported from Florida by Pratt and Seabrook (1952), *mulrennani* was described by Basham in 1948 from the Florida Keys, and *opisthopus* Komp was reported from Florida by Pratt, Wirth, and Denning (1945).

In *Mansonia,* Pratt (1945) reported *indubitans* Dyar and Shannon from Florida. It is the common *Mansonia (Mansonia)* on water lettuce.

In *Orthopodomyia,* Bohart described *californica* in 1950 as a distinct species based principally on larval characters.

In *Psorophora,* Roth (1945) described *longipalpis* and separated it from *horrida* (Dyar and Knab), Joyce (1945) reported *mexicana* Bellardi from Brownsville, Texas, and Thurman, Haeger and Mulrennan (1951) reported *johnstonii* (Grabham) from the Florida Keys.

Tribe Anophelini

Anopheles Meigen

A. (Anopheles) atropos D. and K.
A. (Anopheles) barberi Coq.
A. (Anopheles) bradleyi King
A. (Anopheles) crucians Wied.
A. (Anopheles) earlei Vargas

For differentiation of *earlei* from *occidentalis* see Vargas, Luis and R. Matheson, Rev. Inst. Sal. Enferm-Trop. Mex. 9 (1): 27–33, 1948; Pratt, H. D., Amer. J. Trop. Med. & Hyg. 1 (3):484–493, 1952; and Rozeboom, L. E., Amer. J. Trop. Med. & Hyg. 1 (3):477–483, 1952

A. (Anopheles) franciscanus McCrack.
A. (Anopheles) freeborni Aitk.
A. (Anopheles) georgianus King
A. (Anopheles) occidentalis D. & K.
A. (Anopheles) pseudopunctipennis Theob.
A. (Anopheles) punctipennis (Say)
A. (Anopheles) quadrimaculatus Say
A. (Anopheles) walkeri Theob.
A. (Nyssorhynchus) albimanus Wied.

Tribe Toxorhynchitini

(Tribe Megarhinini of Dyar 1928, Matheson 1944, and others)

The mosquito generic name *Megarhinus* Robineau-Desvoidy 1827 is preoccupied by *Megarhinus* Rafinesque 1820, a genus of fishes. See Stone, Alan, Proc. Ent. Soc. Wash. 50 (6):161, 1948.

Toxorhynchites Theobald

T. rutilus rutilus (Coq.)
T. rutilus septentrionalis (D. & K.)

See Jenkins, D. W., Proc. Ent. Soc. Wash. 51 (5): 225–229, 1949

Tribe Sabethini

Wyeomyia Theobald

W. haynei Dodge

Proc. Ent. Soc. Wash. 49 (5):117–122, 1947

W. mitchellii (Theob.)
W. smithii (Coq.)
W. vanduzeei D. & K.

TRIBE URANOTAENIINI

Uranotaenia Lynch-Arribalzaga

U. anhydor anhydor Dyar
U. anhydor syntheta D. & S.

U. anhydor and *U. syntheta* are here listed as subspecies, although they may actually be one species. See Brookman and Reeves, Ann. Ent. Soc. Amer. 46:235, 1953 or Galindo, Blanton, and Peyton, Ann. Ent. Soc. Amer. 47 (1):118–119, 1954.

U. lowii Theob.
U. sapphirina (O.S.)

TRIBE CULICINI

Aedes Meigen

A. (Aedes) cinereus Meig.
A. (Aedimorphus) vexans (Meig.)
A. (Stegomyia) aegypti (Linn.)
A. (Finlaya) atropalpus (Coq.)
A. (Finlaya) triseriatus (Say)
A. (Finlaya) varipalpus (Coq.)
A. (Finlaya) zoosophus D. & K.
A. (Finlaya) alleni Turner
Synonymy by Gjullin, Proc. Ent. Soc. Wash. 48(9):234, 1946
A. (Feltianus) trichurus (Dyar)
A. (Feltianus) bicristatus Thurman and Winkler
Proc. Ent. Soc. Wash., 52 (5):237–250, 1950
A. (Taeniorhynchus) mitchellae (Dyar)
A. (Taeniorhynchus) nigromaculis (Ludl.)
A. (Taeniorhynchus) sollicitans (Walk.)
A. (Taeniorhynchus) taeniorhynchus (Wied.)
A. (Ochlerotatus) aboriginis Dyar
A. (Ochlerotatus) abserratus (F. & Y.)
Aedes implacabilis of Dyar 1928, Matheson 1944, and many others. Not *implacabilis* Walker according to Vockeroth, Can. Ent. 86 (3):109–116, 1954
A. (Ochlerotatus) atlanticus D. & K.
A. (Ochlerotatus) aurifer (Coq.)
A. (Ochlerotatus) bimaculatus (Coq.)
A. (Ochlerotatus) campestris D. & K.
A. (Ochlerotatus) canadensis canadensis (Theob.)
A. (Ochlerotatus) canadensis mathesoni Middlek.
See Rings, R. W., and S. O. Hill, Proc. Ent. Soc. Wash. 48 (9):237–240, 1946
A. (Ochlerotatus) cantator (Coq.)
A. (Ochlerotatus) cataphylla Dyar
A. (Ochlerotatus) communis (De G.)
A. (Ochlerotatus) decticus H., D. & K.
A. (Ochlerotatus) pseudodiantaeus Smith, Bull. Brook. Ent. Soc. 47 (1):19–40, 1952. Dr. Alan Stone, in a letter dated October 28, 1954, has stated that he believes this synonymy is correct. Dr. Marion Smith has also studied the types and concurs.
A. (Ochlerotatus) diantaeus H., D. & K.
For correct association of all stages of *diantaeus* and *decticus* see Smith, Bull. Brook. Ent. Soc. 47 (1):19–40, 1952.
A. (Ochlerotatus) dorsalis (Meig.)
A. (Ochlerotatus) dupreei (Coq.)
A. (Ochlerotatus) excrucians (Walk.)
A. (Ochlerotatus) fitchii (F. & Y.)
A. (Ochlerotatus) flavescens (Müll.)
A. (Ochlerotatus) fulvus pallens (Ross)
A. (Ochlerotatus) grossbecki D. & K.
A. (Ochlerotatus) hexodontus Dyar
A. (Ochlerotatus) impiger (Walk.)
A. nearcticus Dyar. Synonymy by Vock., Can. Ent. 86 (3):109–116, 1954
A. (Ohclerotatus) implicatus Vock.
Can. Ent. 86 (3):110–112, 1954. This is a new name for *Aedes impiger* of Dyar 1928, Matheson 1944, and many others, not Walker 1848. Vockeroth has examined the types of *impiger* Walker and *nearcticus* Dyar and believes that they are the same, therefore *nearcticus* is a synonym of *impiger*.
A. (Ochlerotatus) increpitus Dyar
A. (Ochlerotatus) infirmatus D. & K.
A. (Ochlerotatus) intrudens Dyar
A. (Ochlerotatus) melanimon Dyar
A. (Ochlerotatus) klotsi Matheson. Dr. Stone and I examined the types of *melanimon* Dyar and *klotsi* Matheson in January 1954 and believe they are the same. In a letter dated Oct. 28, 1954, Dr. Stone has written, "I am not so certain that *melanimon* is a full species, distinct from *dorsalis*, but

I suspect it is."
A. (Ochlerotatus) muelleri Dyar
A. (Ochlerotatus) nigripes (Zett.)
A. (Ochlerotatus) alpinus of authors not Linnaeus Synonymy by Natvig, Norsk. Ent. Tiddskr. 7:99–106, 1945 or Norsk. Ent. Tiddskr. Suppl. 1, 302–310, 1948.
A. (Ochlerotatus) niphadopsis D. & K.
A. (Ochlerotatus) pionips Dyar
A. (Ochlerotatus) pullatus (Coq.)
A. (Ochlerotatus) punctodes Dyar
See Knight, K. L., Ann. Ent. Soc. Amer. 44 (1):87–99, 1951
A. (Ochlerotatus) punctor (Kby.)
A. implacabilis Walker. Synonymy by Vockeroth, Can. Ent. 86 (3):109–116, 1954. *A. implacabilis* of authors becomes *abserratus* Felt and Young.
A. (Ochlerotatus) rempeli Vock.
Can. Ent. 86 (3):112–114, 1954
A. (Ochlerotatus) riparius D. & K.
A. (Ochlerotatus) scapularis (Rond.)
A. (Ochlerotatus) schizopinax Dyar
A. (Ochlerotatus) spencerii (Theob.)
Aedes (Ochlerotatus) idahoensis Theob. is a synonym of *spencerii*.
A. (Ochlerotatus) squamiger (Coq.)
A. (Ochlerotatus) sticticus (Meig.)
(includes also *lateralis* of Matheson, p. 173, 1944, not Meigen 1818)
A. (Ochlerotatus) stimulans (Walk.)
A. (Ochlerotatus) thelcter Dyar
A. (Ochlerotatus) keyensis Buren, Proc. Ent. Soc. Wash. 49 (8):228–229, 1947. Synonymy by Thurman, Haeger, and Mulrennan, Mosq. News, 9 (4):171–172, 1949
A. (Ochlerotatus) thibaulti D. & K.
A. (Ochlerotatus) tormentor D. & K.
A. (Ochlerotatus) tortilis (Theob.)
See Staebler, A. E. and W. F. Buren, Public Health Reports 61:685, 1946, and Thurman, E. B., J. S. Haeger, and J. A. Mulrennan, Ann. Ent. Soc. Amer. 44 (1):144, 1951
A. (Ochlerotatus) trivittatus (Coq.)
A. (Ochlerotatus) ventrovittis Dyar
A. (Kompia) purpureipes Ait.

Culex Linnaeus

C. (Culex) bahamensis D. & K.
C. (Culex) chidesteri Dyar
See Joyce, Mosquito News, 8 (3):102–105, 1948
C. (Culex) coronator D. & K.
C. (Culex) erythrothorax Dyar
C. (Culex) interrogator D. & K.
C. (Culex) nigripalpus Theob.
C. (Culex) pipiens molestus Forsk.
C. (Culex) pipiens pipiens Linn.
C. (Culex) pipiens quinquefasciatus Say
Fundamental studies on the *Culex pipiens* complex are summarized in Mattingly, *et al.,* Trans. Roy. Ent. Soc. London, 102 (7):331–382, 1951, and Rozeboom, L. E. and B. N. Gilford, J. Parasit., 40 (3):237–244, 1954
C. (Culex) restuans Theob.
C. (Culex) salinarius Coq.
C. (Culex) stigmatosoma Dyar
C. (Culex) tarsalis Coq.
C. (Culex) thriambus Dyar
See Galindo, P. and T. Kelley, Pan. Pac. Ent. 19 (3):87–90, 1943
C. (Culex) virgultus Theob.
C. (Culex) declarator D. & K.
Synonymy by Lane, J., Proc. Ent. Soc. Wash., 53 (6):334, 1951 Synonymy by Lane, J., Neotropical Culicidae, 1: 351, 1953
C. (Neoculex) apicalis Adams
See, Bohart, R. M., Ann. Ent. Soc. Amer. 41:330–345, 1948
C. (Neoculex) arizonensis Boh.
Ann. Ent. Soc. Amer. 41:341–342, 1948
C. (Neoculex) boharti Brookman and Reeves (Synonym *Culex reevesi* Bohart not Wirth) Pan. Pac. Ent. 26 (4):159–160, 1950
C. (Neoculex) reevesi Wirth
Biology of Aquatic and Littoral Insects, U. Cal. Syllabus Series.
Syllabus SS. 230–231, 1948
See also Brookman, B. and W. C. Reeves, Ann. Ent. Soc. Amer. 46 (2): 226–231, 1953
C. (Neoculex) territans Walk.
Culex apicalis of Matheson (in part)
See Bohart, R. M., Ann. Ent. Soc. Amer. 41:330–345, 1948
C. (Melanoconion) abominator D. & K.
C. (Melanoconion) anips Dyar

See Brookman and Reeves, Ann. Ent. Soc. Amer., 46:231–234, 1953
C. (Melanoconion) atratus Theob.
C. (Melanoconion) erraticus (D. & K.)
C. (Melanoconion) iolambdis Dyar (Synonym *elevator* Wirth, not Dyar)
See Pratt, H. D. and E. L. Seabrook, Proc. Ent. Soc. Wash. 54 (1):27–32, 1952
C. (Melanoconion) mulrennani Bash. Ann. Ent. Soc. Amer. 41 (1):1–7, 1948
C. (Melanoconion) opisthopus Komp
See Pratt, H. D., W. W. Wirth, and D. G. Denning, Proc. Ent. Soc. Wash. 47 (8):245–251, 1945
C. (Melanoconion) peccator D. & K.
C. (Mochlostyrax) pilosus (D. & K.)
See Foote, R. H., U.S.D.A. Tech. Bull. 1091: 114–116, 1954

Culiseta Felt
C. (Culiseta) alaskaensis (Ludl.)
C. (Culiseta) impatiens (Walk.)
C. (Culiseta) incidens (Thom.)
C. (Culiseta) inornata (Will.)
C. (Culiseta) maccrackenae D. & K.
C. (Culicella) morsitans (Theob.)
C. (Climacura) melanura (Coq.)

Deinocerites Theobald
D. cancer Theob.
D. spanius (D. & K.)

Mansonia Blanchard
M. (Coquillettidia) perturbans (Walk.)
M. (Mansonia) indubitans D. & S.
See Pratt, H. D., J. Kans. Ent. Soc. 18 (4):121–129, 1945
Chamberlain, R. W. and T. E. Duffy, Mosq. News, 5 (3):96–97, 1945
Carpenter, S. J., Middelkauff, W. W. and R. W. Chamberlain, Mosquitoes of S. E. U. S. A., 121–123, 1946
M. (Mansonia) titillans (Walk.)

Orthopodomyia Theobald
O. alba Baker
O. californica Boh.
Ann. Ent. Soc. Amer. 43 (3):399–404, 1950
O. signifera (Coq.)

Psorophora Robineau-Desvoidy
P. (Psorophora) ciliata (Fab.)
P. (Psorophora) howardii Coq.
P. (Janthinosoma) cyanescens (Coq.)
P. (Janthinosoma) ferox (Humb.)
P. (Janthinosoma) horrida (D. & K.)
P. (Janthinosoma) johnstonii (Grab.)
See Thurman, Haeger, and Mulrennan, Ann. Ent. Soc. Amer. 44:144–157, 1951
P. (Janthinosoma) longipalpis Roth
Psorophora (J.) horrida of Matheson, 1944. See Roth, Proc. Ent. Soc. Wash. 47 (1):1–23, 1945
P. (Janthinosoma) mexicana (Bellardi)
See Joyce, C. R., Mosq. News, 5 (3):86, 1945
P. (Janthinosoma) varipes (Coq.)
P. (Grabhamia) confinnis (L.-A.)
P. (Grabhamia) discolor (Coq.)
P. (Grabhamia) pygmaea (Theob.)
P. (Grabhamia) signipennis (Theob.)

SUMMARY

The present check list of the mosquitoes of North America contains 138 species, three with subspecies, in eleven genera as follows: 14 species of *Anopheles;* 1 species of *Toxorhynchites* with 2 subspecies; 4 species of *Wyeomyia;* 3 species of *Uranotaenia, anhydor* with 2 subspecies; 61 species of *Aedes, canadensis* containing 2 subspecies; 27 species of *Culex, pipiens* containing 3 subspecies; 7 species of *Culiseta;* 2 species of *Deinocerites;* 3 species of *Mansonia;* 3 species of *Orthopodomyia;* and 13 species of *Psorophora.* Adult males, females, and fourth stage larvae are known of 136 of the 138 species listed above. In many species the eggs, first, second, and third larval stages, and pupae, have also been described. The immature stages of *Aedes muelleri* Dyar and *Psorophora mexicana* (Bellardi) and the male of *P. mexicana* are still unknown.

Although much of the basic information with regard to the classification of the mosquitoes of North America has now been acquired, there are still many problems needing much additional investigations such as: the ranges of *Anopheles earlei* and *occidentalis* particularly in western North America, the status of the northern forms of *Anopheles walkeri* with

dark halteres and the more southern form with light halteres, the ranges of *Anopheles franciscanus* and *pseudopunctipennis* particularly in the area of overlap, the ranges of *Wyeomyia haynei* versus *Wyeomyia smithii* and the importance of two versus four anal gills in separating these two species or subspecies, the ranges of *Uranotaenia anhydor anhydor* and *Uranotaenia anhydor syntheta,* the composition of the *Aedes dorsalis-melanimon* complex in North America and the determination of the presence or absence of *caspius* in this continent, the relationship of *Aedes punctor* and *punctodes,* additional information on the *Culex pipiens-quinquefasciatus-molestus* complex in North America, and further studies on *Culex stigmatosoma* and *thriambus.*

Acknowledgments

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MOSQUITO RECORDS FROM THE GREAT BASIN AND THE DRAINAGE OF THE LOWER COLORADO RIVER

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The Great Basin and the drainage of the Lower Colorado River represent a vast, naturally defined area in the western United States characterized, except at the higher elevations, by desert vegetation and a precipitation of less than ten inches per year. The Great Basin includes most of Nevada and western Utah and extends from southeastern Oregon and southern Idaho southward into southern California. It is bounded on the east by the Wasatch Mountains and high plateaus of central and southern Utah and on the west by the Sierra Nevada Mountain range of California and Nevada. The drainage basin of the Lower Colorado River includes southern Utah, southeastern Nevada, and most of Arizona. This article, a report on the mosquito fauna of these drainage areas,

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includes all published records from Arizona and Nevada and the counties of western and southern Utah which are within the above boundaries. One new state record from the Great Basin drainage of east central California is also included. Records of the mosquito fauna of the Great Basin regions of southeastern Oregon, southern Idaho, and southern California have been omitted. These records may be obtained from the publications of Freeborn and Bohart (1951) and Stage *et al.* (1952). The mosquitoes included in this paper are primarily those inhabiting the desert plains and valleys, but species from mountains and high plateaus have been included if they occur within the two drainage basins covered in the scope of this paper.

The records presented herein are based upon collections made by personnel of the Water Projects Section and the Logan Field Station, CDC, U. S. Public Health Service, and from specimens in the collection of the University of California at Berkeley, University of California at Los Angeles, University of Utah, University of Nevada, and the E. G. Davis collection deposited with the U. S. Department of Agriculture at Tempe, Arizona. Previous publications containing records include Aitken (1945), Bohart (1948), Dyar (1917, 1922, 1928), Fellton (1944), Murphy (1953), Rees (1934, 1942, 1943, 1944), and Rees and Nielsen (1951, 1955). The authors are grateful to John N. Belkin and W. A. McDonald of the Department of Entomology, University of California at Los Angeles, and William C. Reeves of the University of California School of Public Health for permission to use previously unpublished records from Arizona. Forty-nine mosquito species representing eight genera are included in this paper. Despite this surprisingly large number of species for one of the most arid regions in the United States the list should be considered preliminary since many parts of Arizona, Nevada, and western Utah have not been surveyed intensively for mosquitoes.

The collections presented below are arranged alphabetically by state and county, with the county names in boldface. When more than a single collection for a species was available from the same locality, the first known collection is reported. When individual species were especially abundant and widespread within a county the individual locality records have been omitted. Records based on larval collections only are indicated by (*l.*) inserted after the date. Unspecified records pertain to adult specimens.

Unless otherwise indicated, the collections were made by the authors or by Mr. Barry Valentine who made many of the Nevada collections in the program conducted by the Water Projects Section, USPHS. Other collectors or authors are referred to by abbreviation.

(A) T. H. G. Aitken, (B) R. M. Bohart, (C) H. E. Cott, (D) H. G. Dyar, (E) J. L. Eastin, (ED) E. G. Davis, (F) H. L. Fellton, (H) F. C. Harmston, (JF) J. R. Featherstone, (JR) J. A. Rowe, (K) G. F. Knowlton, (LR) I. La Rivers, (M) D. R. Murphy, (P) C. B. Philip, (R) P. F. Russell, (TR) T. Ryan, (WR) W. C. Reeves, (WM) W. A. McDonald.

List of Species

Genus *Aedes*

A. aegypti (Linnaeus): ARIZONA: **Pima:** Tucson (M, 1953). **Yuma:** Yuma, VIII–3–51 (R).

A. atropalpus (Coquillett): ARIZONA: **Pima:** Sabino Can., VIII–7–53. **Santa Cruz:** Madera Can., VIII–22–54 (WM). UTAH: **Washington:** Zion Nat. Pk., VI–14–39.

A. campestris Dyar & Knab: NEVADA: **Churchill:** Fallon, VII–3–53; Big Soda Lake, IV–24–51 (LR). **Mineral:** Schurz, IV–11–53 (l). **Nye:** 1948 (LR). **White Pine:** Baker, V–9–37. UTAH: **Cache:** Logan, IV–21–31 (K). **Juab:** Fish Springs, VI–9–40; Trout Creek, V–4–37. **Millard:** Clear Lake, V–17–38; Garrison, V–9–37. **Washington:** St. George, IV–12–34. Widespread in the following counties: **Box Elder, Davis, Salt Lake, Tooele, Weber.**

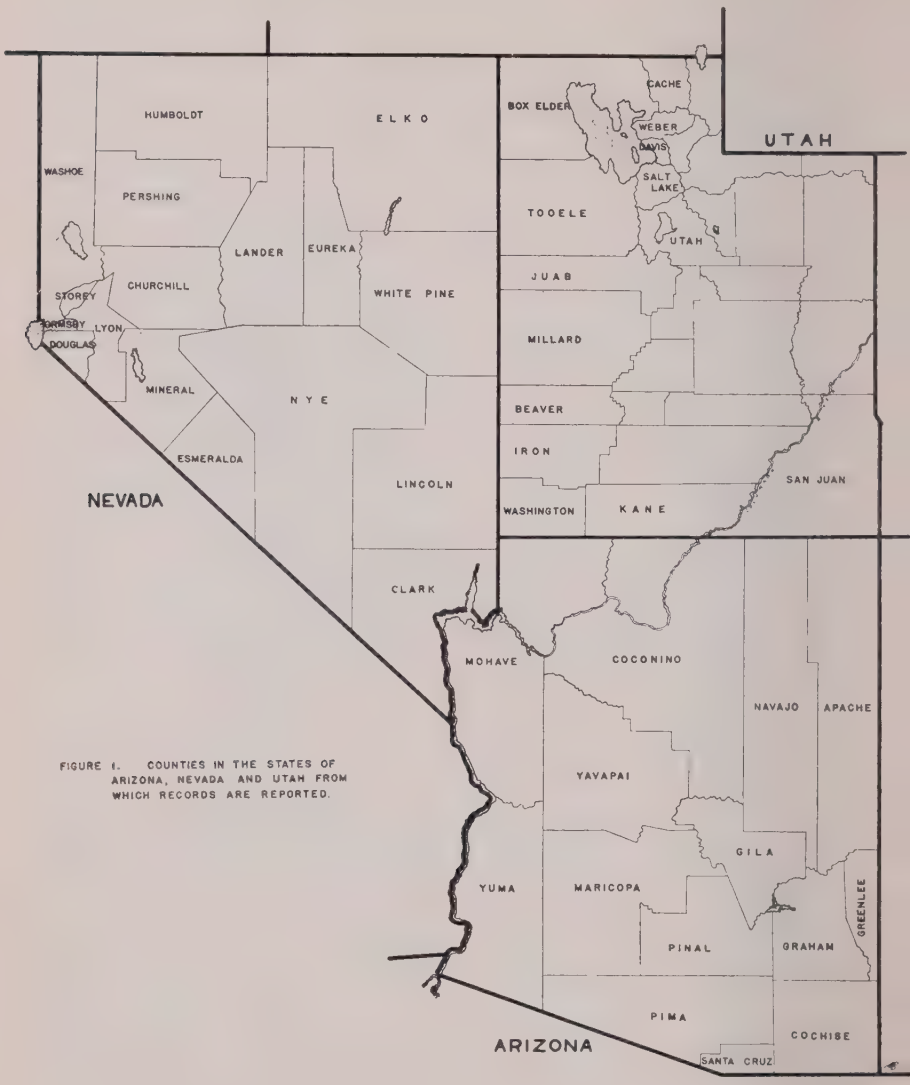

FIGURE 1. COUNTIES IN THE STATES OF ARIZONA, NEVADA AND UTAH FROM WHICH RECORDS ARE REPORTED.

A. cataphylla Dyar: ARIZONA: **Coconino:** Grand Can. Nat. Pk. (N. Entrance), V–31–54. NEVADA: **Douglas:** Glenbrook, VI–5–16 (D, 1917). **Eureka:** Pine Creek (Palisade), IV–19–53 (l). **Ormsby:** Carson City, VII–2–53.

A. cinereus (Meigen): NEVADA: **Lander:** Battle Mtn., VIII–4–53. UTAH: **Cache:** Logan, IV–28–34 (K). **Salt Lake:** Holladay, V–17–46 (l). **Utah:** Provo River, VI–24–38.

A. dorsalis (Meigen): ARIZONA: **Apache:** Springerville, V–26–53 (l); Lyman Dam, V–26–53; St. Johns, V–26–53. **Navajo:** Joseph City, V–26–53 (l). **Pima:** Tucson, IX–2–53. **Yavapai:** Cornville, VII–15–53 (l). **Yuma:** Parker, X–12–53; Yuma, VIII–3–51 (R). NEVADA: **Churchill:** Hazen, IV–16–53 (l); near Fernly, VII–28–53: Fallon, VII–3–53 (l). **Clark:** Glendale, IV–20–53. **Douglas:** Mindon, VI–30–53. **Elko:** Elko, VI–26–53 (l). **Eureka:** Dunphy, VIII–22–53. **Lander:** Battle Mtn., VI–21–53. **Lincoln:** Alamo, IV–20–53 (l); Caliente, VII–30–53. **Lyon:** near Fernly, IV–18–53 (l); near Lahontan Res., IV–16–53 (l); Yerington, VII–23–53 (l); Smith, VII–7–53 (l); Dayton, VII–2–53. **Mineral:** Schurz, VII–23–53. **Ormsby:** Carson City, VII–2–53. **Pershing:** Lovelock, VII–21–53. **Washoe:** Reno, VIII–5–53; Sparks, VIII–7–53. **White Pine:** Baker, V–9–37. UTAH: **Juab:** Fish Springs, VI–9–40; Gandy, V–9–37; Juab, IV–2–33; Yuba Dam, V–9–37. **Kane:** Glendale, IX–9–33. **Millard:** Burbank, V–6–37 (l); Clear Lake, V–17–38(l); Fairbanks, V–6–37; Garrison, V–10–37; Lyndyl, IX–6–36. **San Juan:** Bluff, VI–11–39. **Toole:** Dolomite, IV–9–33 (l); Dugway, VIII–5–52; Grantsville, IV–5–45 (l); Salt Springs, XI–1–30; Wendover, XI–1–30. **Washington:** St. George, VI–17–39. Common and widespread in the following counties: **Box Elder, Cache, Davis, Salt Lake, Utah, Weber.**

A. fitchii (Felt & Young): ARIZONA: **Coconino:** Grand Can. Nat. Pk. (N. Entrance), V–31–54 (l). NEVADA: **Douglas:** Spooner Summit, VII–31–53. **Elko:** Carlin, IV–9–53. **Eureka:** Palisade (Pine Creek), VI–19–53. **Humboldt:** Paradise Valley, VIII–11–53. UTAH: **Cache:** Logan, V–27–33 (K); Mendon, IV–19–54 (l). **Davis:** Farmington, V–6–33. **Juab:** Trout Creek, V–6–34 (JR). **Salt Lake:** Salt Lake City, IV–13–32 (l). **Tooele:** Settlement Creek, VI–12–38. **Utah:** Provo River, VIII–4–37. **Weber:** Ogden, V–10–45 (H).

A. flavescens (Müller): UTAH: **Cache:** Mendon, IV–21–54 (l). **Salt Lake:** Salt Lake City, VIII–21–31.

A. idahoensis (Theobald): NEVADA: **Lander:** Battle Mountain, VII–21–53. UTAH: **Cache:** Logan, V–7–41. **Millard:** Swasey Springs, V–15–38. **Salt Lake:** Salt Lake City, V–24–47 (l).

A. increpitus Dyar: NEVADA: **Douglas:** Glenbrook, VIII–25–15 (D, 1922); Mindon, VII–25–53; E. Lake Tahoe, VII–31–53. **Elko:** Carlin, IV–19–53 (l). **Eureka:** Palisade (Pine Creek), IV–19–53 (l). **Lyon:** Dayton, VII–2–53. **Ormsby:** Carson City, VII–2–53. UTAH: **Box Elder:** Blue Creek, V–19–34; Tremonton, VI–22–45 (H). **Cache:** Logan, VI–15–45 (H); Mendon, IV–19–54 (l). **Davis:** Farmington, V–20–45 (H). **San Juan:** Abajo Mtns. (near Blanding), VI–17–46 (l) (H). **Salt Lake:** Salt Lake City, IV–18–31 (l). **Utah:** Provo Canyon, VI–18–45 (H). **Washington:** Pine Valley, IV–20–50 (l); Pintura, IV–20–50 (l); Zion Nat. Pk., VI–14–39. **Weber:** Ogden, IV–30–45.

A. melanimon Dyar: NEVADA: **Churchill:** Fallon, VI–3–53. **Douglas:** Mindon, VI–27–53. **Elko:** Elko, VI–26–53; Ruby Valley, VII–29–53. **Eureka:** Dunphy, VIII–22–53. **Humboldt:** Paradise Valley, VIII–11–53; Golconda, VIII–10–53. **Lander:** Battle Mtn., VII–22–53. **Lyon:** Dayton, VII–2–53; Smith, VII–7–53; Yerington, VII–8–53. **Mineral:** Schurz, VII–23–53. **Ormsby:** Brunswick Can., VII–26–53; Carson City, VII–2–53. **Pershing:** Lovelock, VIII–10–53.

Washoe: Sparks, VIII–7–53; Reno, VIII–6–53. UTAH: **Cache:** Mendon, VIII–2–54. **Juab:** Topaz, VI–15–44 (JF). **Salt Lake:** Salt Lake City, VI–29–48. **San Juan:** Bluff, VI–10–39.

A. muelleri Dyar: ARIZONA: **Cochise:** Chiricahua Mtns., VIII–17–17 (D, 1922, 1928). **Santa Cruz:** Madera Can., VIII–25–54 (WM).

A. nigromaculis (Ludlow): ARIZONA: **Navajo:** Joseph City, V–26–53; Show Low, VII–19–53 (l). **Yavapai:** Ashfork, VIII–13–53; Yarnell, VII–22–53. NEVADA: Common and widespread in the following counties: **Churchill, Douglas, Lander, Lyon, Mineral, Ormsby, Pershing, Washoe.** UTAH: **Box Elder:** Blue Creek, X–11–34. **Cache:** Amalga, V–17–34 (K); Logan, V–15–54; Logan Meadows, VIII–15–34 (K). **Salt Lake:** Salt Lake City, IV–21–31 (l). **San Juan:** Blanding, VI–10–39 (R); Bluff, VI–10–39. **Weber:** Ogden, VIII–1–35.

A. niphadopsis Dyar & Knab: NEVADA: **Esmeralda:** Coaldale, V–8–39 (A). **Eureka:** Palisade (Pine Creek), IV–19–53 (l). UTAH: **Juab:** Trout Creek, V–4–37. **Millard:** Swasey Springs, V–14–38. Widespread in the following counties: **Box Elder, Davis, Salt Lake, Tooele, Utah, Weber.**

A. pullatus (Coquillett): UTAH: **San Juan:** Abajo Mtns. (near Blanding), VI–17–46 (l) (H).

A. purpureipes Aitken: ARIZONA: **Pima:** Tucson, VII–27–32 (M, 1953); Gardner Can., VIII–24–54 (WM). **Santa Cruz:** Madera Can., VIII–22–54 (WM); Sonoita Creek, VIII–24–54 (WM); Patagonia (A).

A. sollicitans (Walker): ARIZONA: **Yuma:** Wallton (F, 1944).

A. schizopinax Dyar. CALIFORNIA: **Nevada:** Boca, IV–12–53 (l). UTAH: **Cache:** Logan, VI–25–54; Mendon, IV–19–54 (l).

A. sticticus (Meigen): UTAH: **Cache:** Logan, VI–12–54.

A. trivittatus (Coquillett): ARIZONA: **Apache:** Springerville, V–26–53 (l). **Cochise:** Sonoita, VIII–8–53; Fry, VIII–8–53; St. David, VIII–8–53. **Greenlee:** Duncan, IX–17–53. **Santa Cruz:** Lochiel, VIII–8–53; Patagonia, VIII–8–53. **Gila:** Payson, VII–14–53 (l).

A. varipalpus (Coquillett): ARIZONA: **Cochise:** Chiricahua Mtns., VI–17–37 (M, 1953). **Coconino:** Williams, July 29 (D, 1922). **Graham:** Mt. Graham, VII–4–40 (M, 1953). **Pima:** Sabino Basin, Santa Catalina Mts., VIII–23–18 (D, 1922); Santa Rita Mtns., X–20–40 (M, 1953). NEVADA: **Douglas:** Glenbrook, VIII–25–15 (D, 1922). **Ormsby:** Carson City, VII–2–53.

A. vexans (Meigen): ARIZONA: Common and widespread in the following counties. **Apache, Cochise, Graham, Greenlee, Maricopa, Pima, Pinal, Yavapai, Yuma.** NEVADA: Common and widespread in the following counties: **Churchill, Douglas, Elko, Eureka, Humboldt, Lander, Lyon, Mineral, Pershing.** Utah: **Millard:** Swasey Springs, V–16–38; **San Juan:** Blanding, VI–10–39; Bluff, VI–10–39. Common and widespread in the following counties: **Box Elder, Cache, Davis, Salt Lake, Utah, Weber.**

Genus *Anopheles*

A. barberi Coquillett: ARIZONA: **Santa Cruz:** VIII–24–54 (l) (WM).

A. franciscanus McCracken: ARIZONA: Common and widespread in the following counties: **Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma.** NEVADA: **Lyon:** Dayton, X–9–53 (l). **Nye:** Beatty, VII–23–53 (l). **Clark:** Indian Springs, V–26–40 and Tule Springs, V–24–40 (A, 1945). UTAH: **Juab:** Fish Springs, X–28–53. **San Juan:** Monticello, IX–7–53. **Washington:** Hurricane, VI–16–39 (H); Leeds, IV–20–50 (l). St. George, VI–6–30; Washington, VI–16–39.

A. freeborni Aitken: ARIZONA: **Apache:** Concho, V–26–53 (l); Lyman Dam, V–26–53 (l); Springerville, V–26–53

(1). **Cochise:** Douglas (A, 1945); St. David, VII–13–53. **Mohave:** Wickieup, XI–9–53 (1); Big Sandy Wash, XI–15–53 (1). **Navajo:** Show Low, VII–19–53 (1). **Pima:** Arivaca, XII–5–32 (A, 1945). **Yavapai:** Santa Maria River, XI–9–53 (1). NEVADA: Common and widespread in the state. Collected from the following counties: **Churchill, Douglas, Elko, Humboldt, Lander, Lincoln, Lyon, Nye, Ormsby, Pershing, Washoe.** UTAH: **Box Elder:** Tecoma Mtns., VI–2–37. **Juab:** Fish Springs, X–28–53 (1). **Kane:** Kanab, VI–14–39. **Tooele:** Ibapah, XI–2–30; Grantsville, III–23–47. **Washington:** Hurricane, VI–15–39; Leeds, V–2–39; St. George, IV–14–34; Washington, IV–14–34 (1). Zion Nat. Pk., IX–16–30. Common and widespread in the following counties: **Cache, Davis, Salt Lake, Utah, Weber.**

Genus *Culex*

C. apicalis Adams: ARIZONA: **Apache:** McNary, VII–19–53 (1); Alpine, VII–9–53(1). **Coconino:** Sedona, VI–16-53 (1). **Maricopa:** Tortilla Flat, III–20–53 (1); Tempe, IX–27–33 (ED). **Navajo:** Winslow (B, 1948). **Pima:** Sabino Can., III–28–33 (ED); Tucson, IV–11–33 (M, 1953). **Yavapai:** Prescott (B, 1948).

C. arizonensis Bohart: ARIZONA: **Pima:** Santa Catalina Mtns., XI–8–34 (M, 1953). **Santa Cruz:** Madera Can., VIII–25–54 (WM). **Yavapai:** Prescott, VIII–25–47 (B, 1948).

C. boharti Brookman and Reeves: NEVADA: **Washoe:** Verdi, VII–17–53 (1).

C. coronator Dyar and Knab: ARIZONA: **Cochise:** St. David, X–22–53 (1). **Pima:** Arivaca, VI–17–34 and Santa Catalina Mtns., III–27–30 (M, 1953).

C. erythrothorax Dyar: ARIZONA: **Cochise:** St. David, VII–20–53. NEVADA: **Churchill:** Fallon, VII–13–53. **Lyon:** Smith, VIII–14–53. **Nye:** 1949 (P). UTAH: **Cache:** Logan, IV–24–54; Mendon, IV–27–54. **Juab:** Fish Springs, XI–2–30. **Washington:** St. George, XII–20–45. Widespread in the following counties: **Box Elder, Davis, Salt Lake, Weber.**

C. pipiens (Linnaeus): UTAH: **Washington:** St. George, Oct. 1938. Widespread in the following counties: **Box Elder, Davis, Salt Lake, Utah, Weber.**

C. quinquefasciatus Say: ARIZONA: Common and widespread in the state. Collected in the following counties: **Cochise, Graham, Maricopa, Pima, Pinal, Santa Cruz, Yuma.** UTAH: **Salt Lake:** Salt Lake City, IX–24–40. **Washington:** St. George, October 1938.

C. restuans Theobald: ARIZONA: **Santa Cruz:** Sonoita Creek, VIII–25–54 (WM).

C. salinarius Coquillett: UTAH: **Washington:** St. George, XI–20–44 (H).

C. stigmatosoma Dyar: ARIZONA: **Cochise:** Douglas, VIII–18–39 (TR); St. David, VIII–1–53 (1); Tombstone, IX–1–39 (TR); Willcox, IX–17–53 (1). **Pima:** Tucson, XI–4–53. **Pinal:** Coolidge, Oct. 1941 (WR). **Santa Cruz:** Canelo, VIII–8–53 (1); Madera Can., VIII–22–54 (WM); Nogales, VII–15–40 (M, 1953); Sonoita Creek, VIII–24–54 (WM). NEVADA: **Lyon:** Dayton, IX–11–53.

C. tarsalis Coquillett: ARIZONA: Common and widespread. Collected in large numbers in every county except **Greenlee** where it doubtless also occurs. NEVADA: Common and widespread. Collected in every county except **Esmeralda, Eureka,** and **Humboldt.** UTAH: Common and widespread in the following counties: **Box Elder, Cache, Davis, Iron, Juab, Kane, Millard, Salt Lake, San Juan, Tooele, Utah, Washington, Weber.**

C. territans Walker: ARIZONA: **Cochise:** St. David, X–3–53. UTAH: **Cache:** Logan, IV–11–54; Mendon, VI–25–54.

C. thriambus Dyar: ARIZONA: **Apache:** Concho IX–8–53 (1). **Cochise:** St. David, VIII–4–53 (1). **Coconino:** Sedona, VI–16–53 (1). **Gila:** Miami, V–25–53 (1). **Greenlee:** Duncan, IX–17–

53 (1). **Maricopa:** near Mesa, XI–1–53 (1). **Mohave:** Big Sandy Wash, XI–15–53 (1). **Navajo:** Show Low, VII–19–53 (1). **Pima:** near San Xavier Mission, V–8–53 (1); Tucson, X–13–53; **Pinal:** Superior, IX–18–53 (1). **Santa Cruz:** Madera Can., VIII–22–54 (WM); Patagonia, V–9–53 (1). **Yavapai:** Cornville, VII–15–53 (1); Santa Maria River, IX–9–53 (1). Skull Valley, VII–18–53 (1). NEVADA: **Clark:** Cactus Springs, VII–22–53 (1).

Genus *Culiseta*

C. impatiens (Walker): NEVADA: **Elko:** Harrison Pass, VII–29–53 (1). UTAH: **Box Elder:** Raft River Mtns., V–19–48; **Cache:** Logan Cave, II–23–54. **San Juan:** LaSal Mtns., VI–9–39.

C. incidens (Thomson): ARIZONA: Common and widespread. Collected in every county except **Graham, Greenlee,** and **Pinal.** NEVADA: Common and widespread. Collected in the following counties: **Douglas, Lyon, Ormsby, Storey,** and **Washoe.** UTAH: Common and widespread in the following counties: **Box Elder, Cache, Davis, Juab, Kane, Millard, Salt Lake, San Juan, Tooele, Utah, Washington,** and **Weber.**

C. inornata (Williston): ARIZONA: Common and widespread. Collected in every county except **Gila, Graham,** and **Greenlee.** NEVADA: Common and widespread. Collected in every county except **Esmeralda, Humboldt, Mineral,** and **Storey.** UTAH: Common and widespread in the following counties: **Beaver, Box Elder, Cache, Davis, Juab, Kane, Millard, Salt Lake, San Juan, Tooele, Utah,** and **Washington.**

C. maccrackenae Dyar and Knab: ARIZONA: **Santa Cruz:** Patagonia, V–9–53 (1).

Genus *Mansonia*

M. perturbans (Walker): UTAH: **Box Elder:** Perry, VI–28–51. **Cache:** Logan, VI–15–54; Mendon, VI–23–54. **Davis:** August 1951. **Weber:** Ogden, VII–8–43.

Genus *Orthopodomyia*

O. signifera (Coquillett): ARIZONA: **Santa Cruz:** Madera Can., VIII–17–55 (WM).

Genus *Psorophora*

P. confinnis (Lynch-Arribalzaga): ARIZONA: Common and widespread in the following counties: **Cochise, Graham, Greenlee, Maricopa, Pima, Pinal, Yavapai, Yuma.**

P. discolor (Coquillett): ARIZONA: **Cochise:** St. David, VIII–4–53; Douglas, VIII–8–53. **Santa Cruz:** Canelo, VIII–8–53.

P. howardii Coquillett: ARIZONA: **Pinal:** Casa Grande, June 1942 (WR).

P. signipennis (Coquillett): ARIZONA: Common and widespread. Collected in every county except **Apache, Gila, Navajo,** and **Yuma.** UTAH: **Tooele:** Dugway, VIII–4–53 (E).

Genus *Uranotaenia*

U. anhydor Dyar: ARIZONA: **Cochise:** St. David, V–9–53. NEVADA: **Nye:** Fairbanks Springs, Ash Meadows, VIII–21–49 (P).

PUBLISHED RECORDS OF UNCERTAIN OR INVALID STATUS

Anopheles pseudopunctipennis Theobald

ARIZONA: Records of this species reported by Murphy (1953) from Maricopa and Santa Cruz counties are probably *Anopheles franciscanus* McCracken. (See Aitken, 1945:344.)

UTAH: Specimens recorded by Rees (1942, 1943) as this species are *Anopheles franciscanus.*

Anopheles quadrimaculatus Say

ARIZONA: Adult females reported

from Pima County by Murphy (1953) are probably *Anopheles freeborni* Aitken.

Culiseta impatiens (Walker)

ARIZONA: This species was recorded from Flagstaff, Coconino County, by Murphy (1953). As the locality reported is very atypical for this northern mountain species it is likely that another *Culiseta* species is involved.

UTAH: Specimens reported by Rees (1943) from Millard County in western Utah are actually *Culiseta inornata* (Williston).

Culiseta melanura (Coquillett)

ARIZONA: Specimens recorded as this species by Murphy (1953) from Maricopa County are actually *Culiseta inornata.*

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OUTDOOR RESIDUAL TREATMENTS OF PREMISES FOR CONTROL OF SALT-MARSH MOSQUITOES [1]

W. L. BIDLINGMAYER and H. F. SCHOOF

Introduction. Along most of the Atlantic and Gulf coasts of the United States, the salt-marsh mosquitoes, *Aedes taeniorhynchus* (Wiedemann) and *Aedes sollicitans* (Walker) are the principal pest mosquitoes causing annoyance to man both at night and during the day. While considerable effort is directed towards community control of these pests in certain areas, such activities frequently are not feasible in many rural or sparsely populated areas. Therefore, the need existed for a method of mosquito control which could be used by the individual. The efficacy of residual treatments on vegetation for controlling adult mosquitoes had been studied by Madden, *et al.* (1947), who reported that DDT applications in jungle plots would definitely reduce the numbers of *A. taeniorhynchus* for several weeks when applied at a dosage of 2 pounds of DDT per acre.

In attempts to evaluate the potential of outdoor residual treatments for use around homes, emphasis was placed on destroying the mosquitoes that rested in the immediate vicinity of homes during the daytime

[1] From the Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Savannah, Georgia.

period. Based on the observation that adult mosquitoes do not move extensively during the day, it was assumed that the elimination of the adult population within the immediate periphery of a dwelling would afford the householder relief from daytime mosquito annoyance. Such reduction was not expected to have any effect after dusk when mosquitoes infiltrated from the surrounding untreated areas in search of a blood meal.

METHODS. Outdoor residual applications of DDT, dieldrin, BHC, and lindane were made at individual premises near Savannah, Georgia, during 1952, 1953, and 1954. Treatment extended from the foundations of the house outward for approximately 100 feet, the total coverage being about 1 acre. The insecticides were applied to the lawn, shrubbery, flower beds, lower tree trunks, and also to the foundations of the house and outbuildings.

Paired premises were selected in close proximity to each other (usually in adjacent lots) and as similar as possible in amount of vegetation and sunlight, and in type of foundation of the house, that is, whether it was on piers or on a solid foundation. One of the properties in each pair was treated, and the other served as a check.

DDT was formulated as an emulsion from a stock concentrate which consisted of 25 percent DDT, 10 percent rosin, 2 percent Triton X-155, and xylene. In 1954 the rosin was omitted in one series of DDT treatments. Application rates were 2.5, 5, and 10 pounds of DDT per acre.

Dieldrin was employed as an emulsion and as a suspension. The stock concentrate for the dieldrin emulsion was composed of 25 percent dieldrin, 2 percent Triton X-155, and xylene. The emulsion was applied at the rates of 1, 2, and 4 pounds of dieldrin per acre. The suspension treatments were derived from a 50 percent water wettable dieldrin and from an experimental water wettable formulation ("Supona" dieldrin) containing 50 percent dieldrin. Both formulations were sprayed at the rate of 1.5 pounds of dieldrin per acre.

The stock concentrate for BHC consisted of 15 percent BHC, 2 percent Triton X-155, and xylene. Because of the relatively low solubility of technical BHC in xylene, BHC products containing higher gamma isomer content (36 to 41.5 percent) were used for the higher applications to reduce the amount of xylene in the finished formulation and thus decrease the risk of burning ornamental vegetation. BHC was applied at the rate of 0.3, 0.5, 0.6, and 1.3 pounds of gamma isomer per acre.

The lindane concentrate consisted of 12 percent lindane, 2 percent Triton X-155, and xylene. The rate of application of lindane was 0.5 lb. of toxicant per acre.

Each property received treatment with 50 gallons of the finished formulation, the proper acreage dosage being obtained by varying the strength of the formulation. The insecticide was applied at approximately 100 psi with a power sprayer equipped with orchard-type applicators.

The effectiveness of the treatments was evaluated by a comparison of the landing rate indices for the treated and untreated premises. During 1952 and 1953 a 3-minute landing rate was taken daily at one station per premises with an aspirator or with an adult mosquito sampler (Klock and Bidlingmayer, 1953) whenever large numbers of mosquitoes were present. During 1954 the indices were based on 3-minute landing rates at three stations per premises 3 days per week.

During 1952 and 1953 a treated property arbitrarily was considered under control as long as its weekly index was less than one-fourth of the index of the untreated property or was less than 10 mosquitoes. In 1954 the same criteria were employed except that the level was less than six mosquitoes per week.

RESULTS. In 1952, treatments of DDT-emulsion at 5 (three replicates) and 10 (two replicates) pounds of DDT per acre provided an average of 4 and 9 weeks of

effectiveness, respectively, as compared to an average of 2 weeks control in three replicates at a dosage of 2.5 pounds of DDT per acre. The applications of 10 pounds per acre gave excellent results, no mosquitoes being recorded for 6 weeks after the treatment even though indices at the untreated premises for the last 5 weeks were 30 to 73 mosquitoes. Three replicates each of BHC emulsion at 0.3, 0.6, and 1.3 pounds of gamma isomer per acre yielded an average of 2, 0, and 2 weeks reduction of mosquito densities, respectively. Treatments of dieldrin emulsion (three replicates each) at 1.0, 2.0, and 4.0 pounds of dieldrin per acre were least effective, only 1 week of reduced mosquito densities being evident and that was at the maximum dosage.

The 1953 tests which involved five replicates each of DDT emulsion at dosages of 5 and 10 pounds of DDT per acre yielded only 1 and 2 weeks effective reduction in mosquito indices, the latter being achieved with the higher poundage.

In 1954, three replicates each of DDT emulsions with or without rosin applied at a rate of 5 pounds of DDT per acre provided 6 weeks of effective relief from daytime annoyance by salt-marsh mosquitoes. Weekly indices for the treated premises were between 0 and 7 specimens in comparison to the levels of 55 to 302 adults for the untreated adjacent premises. However, neither emulsions of BHC and lindane (three replicates each at 0.5 pound of gamma isomer per acre) nor suspensions of dieldrin (five replicates) at 1.5 pounds of dieldrin per acre, gave more than 1 week of control.

Discussion. From the data it is apparent that limited DDT residual applications around a property can provide a successful means of freeing the occupants from daytime salt-marsh mosquito annoyance for extended periods. Four to six weeks of relief from daytime mosquito annoyance are possible from a single treatment of 5 pounds of DDT per acre. In the Savannah, Georgia, area where both species of salt-marsh mosquitoes are susceptible to DDT, this insecticide markedly surpassed both dieldrin and lindane in efficacy. However, the disappointing results of 1953 indicated that even the DDT applications are not effective for prolonged periods under all conditions. During 1953 general mosquito annoyance and rainfall were much greater than in 1954 and these factors are presumed to have been responsible for the reduced efficacy of the 1953 treatment.

Summary. Residual treatments of DDT to the vegetation and lower portions of outbuildings within a radius of 100 feet from the house were superior to similar applications of dieldrin, lindane, and BHC in providing inhabitants with relief from daytime annoyance by salt-marsh mosquitoes in the Savannah, Georgia, area. Under moderate conditions of mosquito infestation, application of DDT at 5 and 10 pounds per acre produced effective reductions in mosquito densities for 4 to 6 and 9 weeks respectively. Under conditions of repeated heavy mosquito infestations, effective control with either dosage did not exceed 2 weeks. Protection afforded by treatments of dieldrin (1.0 to 4.0 lbs./acre), BHC (0.3 to 1.3 lbs. gamma isomer/acre), and lindane (0.5 lb./acre) ranged from 0 to 2 weeks.

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SEASONAL VARIATIONS IN SUSCEPTIBILITY OF SALT-MARSH MOSQUITO LARVAE TO INSECTICIDES[1]

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Several mosquito-control districts in Florida have encountered seasonal changes in the susceptibility of salt-marsh mosquitoes, *Aedes taeniorhynchus* (Wied.) and *sollicitans* (Wlkr.), to aerial sprays of DDT and BHC. Usually both larvae and adults were reported to be more easily controlled in the winter and spring than in summer and fall, irrespective of any resistance that might have been developed through the use of insecticides.

To study these variations under laboratory conditions, larvae of mixed populations of *Aedes taeniorhynchus* and *sollicitans* were collected at various times between January and September 1953 from three salt marshes in Brevard County, Fla., and were tested for susceptibility to several insecticides. Two marshes, North Causeway and Yoder, were in the Cocoa Beach area, which has been intensively treated with insecticides for several years, and larval resistance to DDT was considered to be exceptionally high (Deonier and Gilbert 1950). The third marsh, No. 8 in the Shiloh area, had been treated occasionally and the larvae were considered to be slightly or moderately resistant to DDT (Keller and Chapman 1953). The three marshes were sprayed two or more times from the air between the first and last collections.

Larvae were collected when they were in the late third or early fourth instar and transported to the laboratory. The test procedure consisted of exposing 25 fourth-instar larvae in 250 ml. of a colloidal suspension of an insecticide made by adding an acetone solution to distilled water. Duplicate tests at concentrations ranging from 0.05 to 0.001 p.p.m. were made with DDT, lindane, toxaphene, dieldrin, aldrin, EPN, malathion, parathion, chlordane, or heptachlor. Mortality counts were taken after 48 hours of exposure at 70° F., and the results were plotted on log-probability paper. The concentrations required to cause 70-percent mortality (LC-70) as read from a line fitted by eye are given in table 1.

Larvae collected from North Causeway marsh in March and April were considerably more susceptible to all the insecticides than larvae collected in July. Larvae collected from Yoder marsh in January were more susceptible than those collected in August, and both lots were more susceptible than a lot collected in September. In both of these marshes resistance was higher than at marsh No. 8, particularly at the end of the season. Larvae collected from this marsh in February were more susceptible than those collected in July and August.

In general, the seasonal trend was similar in the three areas. Larvae tested in the winter and spring were more susceptible to all the insecticides than those tested in the summer and fall. The seasonal increase in resistance was more pronounced with the chlorinated hydrocarbon than with the organic phosphorus insecticides.

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[1] This work was conducted at the Orlando, Fla., laboratory of the Entomology Research Branch under funds allotted to the Branch by the Department of the Army.

TABLE 1.—Estimated LC-70 (in p.p.m.) of 10 insecticides to mosquito larvae from three salt marshes

	North Causeway marsh			Yoder marsh			Marsh No. 8		
Insecticide	Mar. 26	Apr. 30	July 27	Jan. 26	Aug. 24	Sept. 21	Feb. 12	July 23	Aug. 24
Aldrin	0.0011	0.0015	0.0058	0.0023	0.0046	0.016	<0.001	0.0022	0.0024
Chlordane	.0055	.0020	>.025	.0041	.011	>.05	.0021	.012	.014
DDT	.011	.0067	>.05	.015	>.05	>.05	.0070	.027	.050
Dieldrin	.0015	.0012	.0049	.0019	.0022	.0090	.0010	.0021	.0019
EPN	<.001	<.001	.0018	<.001	.0011	.0036	<.001	.0016	.0017
Heptachlor	.0011	.0012	.0036	.0025	.0042	.....	<.001	.0013	.0016
Lindane	.0022	.0041	.018	.0018	.011	>.025	.0037	.014	.011
Malathion	.045	.0090	>.05	.019	>.05	>.05	.030	>.05	>.05
Parathion	.0014	.0016	.0022	.0012	.0014	.0034	.0010	.0027	.0013
Toxaphene	.0022	.0038	>.025	.0054	.0050	>.025	.0039	.012	.0080

NOTES AND DISTRIBUTION RECORDS OF *ANOPHELES* AND *CHAGASIA* MOSQUITOES IN PANAMA BASED ON A THREE YEAR LIGHT TRAP SURVEY

FRANKLIN S. BLANTON [1] AND E. L. PEYTON [2]

This paper is the first of a series of small papers giving the distribution of Panama mosquitoes based on light trap operations. As pointed out by Blanton *et al.* (1955) a very comprehensive survey of the Republic of Panama was conducted during 1951 to 1953 inclusive, using light traps. This was done primarily for the purpose of establishing the distribution of *Anopheles* mosquitoes in the Republic of Panama. Both the New Jersey type light trap and the Shannon dawn trap were used in these operations; however, the Shannon trap was used less frequently. It is the purpose of this paper to record the distribution of *Anopheles* and *Chagasia* mosquitoes taken in these light trap operations. As pointed out in the paper cited, 240,573 mosquitoes, 425,141 *Culicoides,* and 39,023 *Phlebotomus* were taken. There were other biting Diptera such as Tabanidae and Simuliidae, which will be treated in other manuscripts.

There are many mosquitoes that are diurnal and are not attracted to light. The sabethines, represented by four genera in Panama (*Limatus, Trichoprosopon, Sabethes,* and *Wyeomyia*) are not especially attracted to lights. Most of the *Haemagogus* species are only slightly attracted to light and there are other genera in this category. It is planned to treat each genus in a series of short papers where the numbers of specimens taken will permit.

The present paper deals with the genus *Anopheles,* the species of which have caused more misery than any other group of insects. *Chagasia bathanus* has also been included. A total of fifteen species of *Anopheles* have been taken in our surveys.

These are as follows: *albimanus, albitarsis, anomalophyllus, apicimacula, aquasalis, argyritarsis, eiseni, neivai, neomaculipalpis, oswaldoi, punctimacula, pseudopunctipennis, squamifemur, strodei* and *triannulatus.*

Other species of *Anopheles,* that the authors have taken in Panama by other methods include *kompi, parapunctipennis, vestitipennis,* and *xelajuensis.* This makes a total of 19 species collected by the authors in Panama. Of these 19 species, *Anopheles albimanus* is thought to be the cause of most malaria cases in Panama; however, *Anopheles punctimacula* has no doubt been responsible for a number of cases.

The following species of *Anopheles* have been found infected in nature: *albimanus, albitarsis, aquasalis, argyritarsis, pseudopunctipennis, punctimacula, strodei,* and *vestitipennis.*

Komp (1942) has published an excellent treatise on the anophelines of Panama and Arnett (1947) published many new records of the distribution of Panama species. *Anopheles squamifemur* is not listed in either of these publications. It is easily distinguished from all other anophelines by having a very prominent tuft of long black scales on the hind femur.

We have listed the species alphabetically regardless of subgenera, and have also listed the provinces and localities alphabetically. We have treated the Canal Zone as a province of Panama although actually it is a part of the Colon and Panama Provinces. The dates have been listed by month. In some localities several surveys were made during a given month and the dates are given from the first to the last night's operation in that locality for that

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month. For instance: Mojinga Swamp, 15–28 Aug., (7); Means that at least two and perhaps more surveys were made from 15–28 August and a total of seven (7) specimens were taken.

Anopheles albimanus and *Anopheles punctimacula* have the widest distribution. Some species are very rare. *Anopheles squamifemur* is very rare in the Canal Zone. Only one male has been taken and that was in the Mojinga Swamp.

Distribution Records

Chagasia (Anopheles) bathanus Dyar, Carnegie Ins. Wash., Pub. 387, 433, 1928. (Type Loc.: Gatun, C. Z.) **Bocas del Toro:** Almirante, 10–26 Nov. (38); 1–16 Dec. (51); 6–13 Jan. (11); 17–29 Apr. (20). **Canal Zone:** Madden Dam, 21 Sept. (5), Loma Boracho, 26 June (3); 2 July (2); Loma Boracho, Position 9, 12 May (2); Mojinga Swamp, 8–30 Jan. (6); 29 Apr. (1); 7–21 May (21); 21–23 July (6); 15 Aug. (1); 24–29 Oct. (26); 8–26 Nov. (17); 4–5 Dec. (4). **Cocle:** Rio Hato, 27 June (4). **Los Santos:** Pena Blanca, 27 Oct. (1). **Panama:** Cerro Azul, "Sta C", 4 June (1); Cerro Campana, 23 Apr. (1); Nuevo Emperador (Paja), 13 Oct. (1); Pacora, 17 Feb. (2).

Anopheles albimanus Wiedemann, Dipt. Exot., *1*:10, 1821. (Type Loc.: Ins. St. Domingo [Hispaniola].) **Bocas del Toro:** Almirante, 15–30 Apr. (17); 1 May (48). **Canal Zone:** Fort Davis, 11 May (1); Fort Sherman, 29 Apr. (1); France Field, 22 Apr. (3); Galeta Island, 31 Oct. (1); Gatun Lake (Atlantic Side) 2 May (1); Las Cruces, 25 Jan. (1); Loma Boracho, 8 July (1); Loma Boracho, Position 9, 8 May (1); 23 June (1); 17 July (1); Madden Dam, 28 Apr. (4); 21 Sept. (3); Mandinga River, 17 Jan. (29); 28 Mar. (19); 25 Apr. (8); 13 May (15); 15 May (64); Mindi Dairy, 12 June (12); 3 Dec. (16); Mojinga Swamp, 3–30 Jan. (14); 13–15 May (5); 7 Feb. (1); 29 Apr. (3); 6–14 May (96); 10 July (1); Mojinga Swamp, Station 1, 15–28 Aug. (7); Mojinga Swamp, Station 2, 29 Oct. (12); 8–28 Nov. (17); 5–10 Dec. (8); Mojinga Swamp, Station 4, 28 Aug. (1); Tarpon Club, 16 Oct. (1). **Chiriqui:** Boca Chica, 18 Dec. (1); David, 15 Dec. (1); Tortugas, 16 Dec. (4). **Cocle:** Aguadulce, 25 Sept. (18); Anton, 11 Nov. (3); Chiru, 10 Nov. (2); El Barrero, 12 Nov. (2); El Cristo, 22 Nov. (2); Penonome, 23 Nov. (3); Port of Farallon, 9 Nov. (5); Rio Hato, 27 June (1); 24–26 Sept. (26). **Colon:** Cativa, 27 Aug. (11); Piña, 18 Aug. (2). **Darien:** El Real, 19 Mar. (7); 20–21 July (145); 8 Aug. (215); Garachine, 16–23 Feb. (14); Jaque, 24–28 July, (14); 10–12 Aug. (56); Patino Point, 12–26 July (34); 6–28 Aug. (60); 1–27 Sept. (6). **Herrera:** Ocu, 25 Nov. (11); Los Pozos, 22 Oct. (1); Paris 23 Oct. (4); Pese, 22 Oct. (1). **Los Santos:** Las Lajas, 26 Oct. (1); Port Mensabe, 22 Oct. (1); Santo Domingo, 26 Oct. (1). **Panama:** Arraijan, 22 Jan. (3); 26 Mar. (2); 7 Apr. (2); 24 June (10); 2–14 Aug. (10); 14 Sept. (1); 7 Oct. (1); Camaron, 23 June (1); 17 July (2); 17 Oct. (4); Capitana, 25 Sept. (44); Chepo, 25 Sept. (11); El Coco, 10 Sept. (1); Juan Diaz, 24 Sept. (2); La Chorrera, 8 Sept. (1); La Jolla, 6–20 Mar. (9); 26 June (1); 31 Aug. (13); 7–23 Sept. (7); Naranjal, 1 Oct. (1); Nuevo Emperador, (Paja), 13 Oct. (1); Old Panama, 26 Sept. (20); Pacora, 27 Jan. (10); 29 Sept. (3); Palm Beach, 17 Sept. (1); Pan de Azucar, 10 Oct. (1); Pena Blanca, 9 Sept. (3); Port of Chorrera, 9 Sept. (3); Rio Las Lajas, 17 Sept. (1); Tocumen, 5–29 Jan. (154); 4–10 Feb. (205); 14 Apr. (1); 2–29 Sept. (21); 17 Nov. (3); 4–21 Dec. (85); Venado Beach, 28 July (1); Vique Cove, 7 Oct. (125). **Perlas Islands:** Rey Island, 27 Jan. (3); **Veraguas:** Divisa, 25 Nov. (4); Las Palmas, 16 July (1); Santiago, 24 Nov. (1); Sapatillo, 14 July (2).

Anopheles albitarsis Arribalzaga, El Nat. Arg., *1*:151, 1878. (Type Loc.: El Baradero, Argentina). **Cocle:** Chiru, 10 Nov. (10).

Anopheles anomalophyllus Komp, Proc. Ent. Soc. Wash. *38*:160, 1926. (Type

Loc.: Almirante, Panama.) **Chiriqui:** David, 13 Dec. (1); Pedregal, 13 Dec. (1). **Cocle:** Chiru, 10 Nov. (11). **Veraguas:** El Maria, 14 July (1).

Anopheles apicimacula Dyar and Knab, Proc. Biol. Soc. Wash. 19:136. (Type Loc.: Livingston, Guatemala.) **Bocas del Toro:** Almirante, 12–27 Jan. (23); 15–28 Apr. (6); 11 Nov. (1); 11 Dec. (2). **Canal Zone:** Albrook Field, 19 June 4); Fort Clayton, 1 July (8); Fort Davis, 28 Aug. (2); 6 Nov. (4); Fort Kobbe, 17 Oct. (3); Fort San Lorenzo, 15 Aug. (1); Fort Sherman, 7 June (1); Galeta Island, 31 Oct. (2); 5 Nov. (1); Huile Sia Clara, 13 Oct. (1); Las Cruces, 25 Jan. (8); Loma Boracho, 18–26 June (155); 2–22 July (180); 29 Oct. (1); Loma Boracho, Position 9, 19–23 June (12); 7–24 July (18); Madden Air Strip, 25 Feb. (14); 9 Oct. (3); Mandinga River, 17 Jan. (5); 13–15 May (15); Mindi Dairy, 15 Aug. (3); Mojinga Swamp, 2–31 Jan. (28); 6–27 Feb. (3); 28–29 Apr. (3); 5–21 May (122); 17–30 June (123); 1–28 July (457; 15 Aug. (18); Mojinga Swamp, Station 1, 4 Oct. (1); 15–27 Nov. (28); 11–18 Dec. (6); Mojinga Swamp, Station 2, 21 Aug. (1); 29 Oct. (67); 8–28 Nov. (97); 5–10 Dec. (10); Mojinga Swamp, Station 4, 5 Sept. (2); 7–26 Nov. (3); 4 Dec. (1); Tarpon Club (Atlantic Side), 16 Oct. (3). **Chiriqui:** David, 17–18 Dec. (2); El Volcan, 6 Dec. (2); Horconcitos, 18 Dec. (3); Tortugas, 16 Dec. (1). **Cocle:** El Valle, 23 Jan. (2); 4 Aug. (1); Chiru, 10 Nov. (1); Penonome, 23 Nov. (1). **Colon:** Cativa, 27 Aug. (23); New Chagres, 19 Aug. (2). **Darien:** Patino Point, 16–18 July (15); 13–17 Aug. (2). **Los Santos:** Port Mensabe, 22 Oct. (1). **Panama:** Camaron, 23 June (1); Cermeno, 11 Sept. (9); La Jolla, 7–27 Mar. (10); Pan de Azucar, 10 Nov. (8); Potrero, 11 Sept. (2); Tapagra, 1 Oct. (1); Tocumen, 6–7 Jan. (3); 4–13 Feb. (4); 29 Sept. (1). **Veraguas:** El Maria, 14 July (1); Las Palmas, 10 July (1); Santiago, 24 Nov. (1) Sapotillo, 14 July (21).

Anopheles aquasalis Curry, Am. Jour. Hyg. *15*:566, 1932. (Type Loc.: Panama.) **Canal Zone:** Fort Sherman, 7 June (1); For San Lorenzo, 15 Aug. (1); France Field, 22 Apr. (1); Galeta Island, 31 Oct. (3); 5 Nov. (1); Loma Boracho, 22 July (1); Mandinga River, 17 Jan. (1); Mindi Dairy, 15 Aug. (1); Mojinga Swamp, 7 Jan. (3); 5 Feb. (1); 13 May (1); 17 June (1); 14 July (1); 21–22 Aug. (3); 29 Oct. (4); 8 Nov. (2); 12 Dec. (1).

Anopheles argyritarsis Robineaux-Desvoidy, Mem. Soc. Hist Nat., Paris, *3*:411, 1827 (Type Loc.: Brazil.) **Chiriqui:** Tortugas, 16 Dec. (1). **Cocle:** Chiru, 10 Nov. (9); Port of Farallon, 9 Nov. (1). **Herrera:** Ocu, 25 Nov. (1).

Anopheles eiseni Coquillett, Jour. N. Y. Ent. Soc., *10*:192, 1902. (Type Loc.: Aguna, Guatemala.) **Bocas del Toro:** Almirante, 7–19 Jan. (3); 24 Nov. (1). **Canal Zone:** Fort Sherman, 7–24 June (2); Huile Sia Clara, 10 Oct. (1); Loma Boracho, 26 June (1); 8–22 July (7); 29 Oct. (2); Loma Boracho, Position 9, 23 June (1); Madden Dam, 27 June (1); Mojinga Swamp, 3–19 Jan. (3); 28 Apr. (1); 24 June (1); 9–21 July (4); Mojinga Swamp, Station 1, 15–27 Nov. 10–18 Dec. (1); Mojinga Swamp, Station 2, 21 Aug. (1); 29 Oct. (1); 14–28 Nov. (11); 5–10 Dec. (3); Mojinga Swamp, Station 4, 5 Sept. (5); 24 Oct. (3); 7 Nov. (2); 4–12 Dec. (4). **Panama:** Bayano, 8 Apr. (1); La Jolla, 31 Aug. (1). **Los Santos:** Pedregoso, 28 Oct. (1).

Anopheles neivai Howard, Dyar & Knab, Mosquitoes of N. and C. Amer. and W.I. (Type Loc.: Panama.) **Bocas del Toro:** Almirante, 7–21 Jan. (8); 10–26 Nov. (4); 11–14 Dec. (2). **Canal Zone:** Fort Davis, 28 Aug. (1); Fort Sherman, 7 June (1); Loma Boracho, 26 June (1); Mojinga Swamp, 2–31 Jan. (15); 7 Feb. (1); 7–21 May (44); 17–30 June (5); 9–23 July (31); 4–21 Aug. (4); 5 Sept. (1); 24–29 Oct. (23); 8–28 Nov. (43); 4–12 Dec. (26).

Anopheles neomaculipalpus Curry, Am. Jour. Hyg., *13*:643, 1931. (Type Loc.: Panama, R. de P.) **Canal Zone:** Fort Davis, 6 Nov. (1); Fort Kobbe, 17 Oct.

(3); Loma Boracho, 8 July (2); Mandinga River, 17 Jan. (1); Mindi Dairy, 15 Aug. (15); 3–17 Dec. (217); Mojinga Swamp, 8–19 Jan. (11); 10 July (1); 20 Nov. (4); 4–11 Dec. (2). **Chiriqui:** Boca Chica, 18 Dec. (11); David, 17 Dec. (1); Horconcitos, 18 Dec. (1). **Cocle:** Aguadulce, 25 Sept. (4); Anton, 11 Nov. (53); Chiru, 22 Nov. (1); El Cristo, 22 Nov. (1); La Venta, 8 Nov. (1); Nata, 20 Nov. (1); Pocri, 21 Nov. (3); Port Farallon, 8–9 Nov. (32); Port Obaldia, 11 Nov. (207); Rio Hato, 8–9 Nov. (4); Villa Real, 12 Sept. (4). **Darien:** El Real, 20 July (2); 8–21 Aug. (14); Patino Point, 12–14 July (2); 17 Aug. (17). **Herrera:** Ocu, 25 Nov. (4); Paris, 23 Oct. (15); Parita, 23 Oct. (4); Pese, 22 Oct. (2). **Los Santos:** Pedregoso, 28 Oct. (1); Santo Domingo, 26 Oct. (2). **Panama:** Arraijan, 7 Oct. (1); Camaron, 17 July (1); 17 Oct. (2); Capitana, 25 Sept. (121); Chepo, 25 Sept. (8); Juan Diaz, 24 Sept. (28); La Chorrera, 8 Sept. (1); La Jolla, 31 Aug. (4); Naranjal, 1 Oct. (1); Nueva Gorgona, 16–29 Sept. (84); Pacora, 27 Jan. (7); Pan de Azucar, 10 Oct. (9); Rio Las Lajas, 17 Sept. (3); Tapagra, 1 Oct. (2); Tocumen, 5–29 Jan. (225); 4–6 Feb. (217); 2–29 Sept. (142); 17 Nov. (307); 4–21 Dec. (351).

Cellia oswaldoi Peryassú, 1922, A Folha Med., III, p. 179. (Type Loc.: Espirito Santo, Rio de Janeiro, Minas Gerais, Brazil.) **Canal Zone:** Fort Sherman, 7 June (10); Loma Boracho, 18–26 June (250); 2–22 July (199); 17–29 Oct. (16); Loma Boracho, Position 9, 2–12 May (7); 19–23 June (14); 7–24 July (12); Mindi Dairy, 3 Dec. (2); Mojinga Swamp, 3–30 Jan. (463); 5–7 Feb. (41); 16–29 Apr. (14); 7–20 May (151); 17–30 June (218); 1–28 July (873); 15 Aug. (9); Mojinga Swamp, Station 1, 15–28 Aug. (136); 4 Oct. (57); 15–27 Nov. (171); 11–18 Dec. (86); Mojinga Swamp, Station 2, 21 Aug. (229); 29 Oct. (1905); 8–28 Nov. (2250); 5–10 Dec. (306); Mojinga Swamp, Station 3, 22 Aug. (1); Mojinga Swamp, Station 4, 28 Aug. (62); 4–5 Sept. (178); 24 Oct. (72); 7–26 Nov. (80); 4–12 Dec. (117). **Colon:** Piña, 18 Aug. (1). **Panama:** La Jolla, 25 June (2); 7 Sept. (2). **Veraguas:** Sapotilla, 14 July (3).

Anopheles punctimacula Dyar and Knab, Proc. Biol. Soc. Wash., *19*:136, 1906. (Type Loc.: Colon, Panama.) **Bocas del Toro:** Almirante, 12–26 Jan. (2); 20–29 Apr. (24). **Canal Zone:** Fort Sherman, 7 June (2); Loma Boracho, 18–26 June (182); 2–22 July (133); 23–29 Oct. (36); Loma Boracho, Position 9, 8 May (1); 19–23 June (7); 7–24 July (9); Madden Dam, 27 June (1); 21 Sept. (1); Mandinga River, 17 Jan. (16); 25 Apr. (1); 13–15 May (6); Mindi Dairy, 3–17 Dec. (12); 12 June (9); 15 Aug. (1); Mojinga Swamp, 2–31 Jan. (276); 5–26 Feb. (11); 16–29 Apr. (7); 2–21 May (130); 17–30 June (53); 9–28 July (359); 15 Aug. (12); Mojinga Swamp, Station 1, 15–28 Aug. (23); 4 Oct. (5); 15–27 Nov. (38); 11–18 Dec. (11); Mojinga Swamp, Station 2, 21 Aug. (56); 29 Oct. (328); 8–28 Nov. (900); 5–10 Dec. (116); Mojinga Swamp, Station 4, 28 Aug. (4); 24 Oct. (6); 7–26 Nov. (10); 4–12 Dec. (18); Tarpon Club (Atlantic Side), 16 Oct. (1). **Chiriqui:** David, 15–16 Dec. (3). **Cocle:** Aguadulce, 7 Aug. (7); 25 Sept. (196); Anton, 11 Nov. (1); Rio Hato, 24–26 Sept. (3); **Colon:** Cativa, 27 Aug. (10); Salud, 20 Aug. (1). **Darien:** Patino Point, 16–18 July (15); 14–17 Aug. (21). **Herrera:** Paris, 23 Oct. (7); Pese, 22 Oct. (2). **Los Santos:** Pena Blanca, 9 Sept. (3). **Panama:** Arraijan, 22 Jan. (2); 2–14 Aug. (19); 14 Sept. (14); Camaron, 23 June (3); Capitana, 25 Sept (9); Chepo, 25 Sept. (17); Juan Diaz, 24 Sept. (34); La Chorrera, 8 Sept. (4); La Jolla, 6–27 March (9); 31 Aug. (15); 7–22 Sept. (10); Old Panama, 26 Sept. (3); Pacora, 27 Jan. (11); 5 Feb. (5); 18 May (1); 29 Sept. (2); Palma Beach, 17 Sept. (1); Tocumen, 5–29 Jan. (207); 4–10 Feb. (76); 23–29 Sept. (29); 17 Nov. (32); 4–20 Dec. (26); Vique Cove, 7 Oct. (5). **Veraguas:** Sapotilla, 14 July (1).

Anopheles pseudopunctipennis Theobald, Mon. Cul., *2*:305, 1901. (Type

Loc.: Grenada, B.W.I.) **Bocas del Toro:** Almirante, 30 Apr. (1); 1 May (2). **Canal Zone:** Loma Boracho, 16 July (2); Loma Boracho, Position 9, 12 May (4); Mojinga Swamp, 29 Apr. (2); 7–21 May (14); 25–30 June (5); 28 Aug. (22). **Cocle:** Rio Hato, 25 June (1); 3 Aug. (1). **Herrera:** Los Pozos, 22 Oct. (3); Ocu, 21 March (2); Pese, 22 Oct. (5). **Los Santos:** Guarare, 23 Oct. (1); La Yeguada, 21 Oct. (2); Las Lajas, 26 Oct. (1); Las Palmas, 26 Oct. (1); Los Santos, 24 Oct. (3); Pena Blanca, 27 Oct. (4); Santo Domingo, 26 Oct. (1). **Panama:** Arraijan, 26 March (1); 24 June (3); Cabuya, 16 Sept. (1); Camaron, 23 June (1); 17 July (2); La Jolla, 29 Apr. (1); Pacora, 18 March (3); Potrero, 11 Sept. (1); Tocumen, 14 Apr. (1). **Veraguas:** El Maria, 14 July (2); Santiago, 24 Nov. (1); Sapotilla, 14 July (2).

Anopheles squamifemur Antunes, Bull. Ent. Res. *28*:69, 1937. (Type Loc.: Restrepa, Meta, Columbia.) **Bocas del Toro:** Almirante, 14–21 Jan. (3); 2 Feb. (2); 17–26 Nov. (15); 1–11 Dec. (6). **Canal Zone:** Mojinga Swamp, 30 Jan. (1); 5 Feb. (1); 14–29 Apr. (53); 7–20 May (38); 25–30 June (26); 1–23 July (24); 15–17 Nov. (5); 24–29 Oct. (6); 4–12 Dec. (4).

Anopheles strodei Root, Amer. Jour. Hyg. *6*:711, 1926. (Type Loc.: Juiz de Fora, Minas Gerais, Brazil.) **Cocle:** Anton, 11 Nov. (2). **Panama:** Pacora, 29 Sept. (2); Tocumen, 21 Jan. (11); 4–10 Feb. (209); 29 Sept. (14); 17 Nov. (126); 4 Dec. (4).

Cellia triannulata Neiva and Pinto, 1922, Brazil-Medico, *36*:356. (Type Loc.: Matto Grosso, Brazil.) **Canal Zone:** Loma Boracho, 26 June (1); Madden Dam, 8 Oct. (1); Mandinga River, 25 Apr. (77); 13–15 May (283); Mojinga Swamp, 20 May (1); 17 June (1); 29 Oct. (2). **Chiriqui:** Boca Chica, 18 Dec. (1). **Cocle:** Aguadulce, 25 Sept. (6); Villa Real, 12 Sept. (3). **Colon:** Cativa, 27 Aug. (2). **Herrera:** Parita, 23 Oct. (5); Pese, 22 Oct. (1). **Los Santos:** Pena Blanca, 9 Sept. (1); Las Tablas, 24 Oct. (1). **Panama:** Arraijan, 24 June (1); Camaron, 17 July (2); Capitana, 25 Sept. (5); La Chorrera, 8 Sept. (2); Pacora, 27 Jan. (5); Tocumen, 20–29 Jan. (154); 4–6 Feb. (319); 29 Sept. (9); 17 Nov. (2); 4 Dec. (1).

SUMMARY

This paper represents the first in a series of short papers dealing with the distribution of Panama mosquitoes based on the light trap studies conducted in Panama by the 25th Medical Detachment of Fort Clayton, Canal Zone.

The present paper presents the distribution of 15 of the 19 species of *Anopheles* mosquitoes collected by the authors in Panama, and of *Chagasia bathanus,* the only species of this genus known to occur in Panama.

Other small papers will follow giving results of light trap operations in Panama for orther genera of mosquitoes.

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A NOTE ON SOME VARIATIONS IN THE STRUCTURE OF THE SALIVARY GLANDS OF *ANOPHELES ALBIMANUS* WIEDEMANN (DIPTERA: CULICIDAE) [1]

DINNIEMAUD V. JENSEN

Christophers (1901), Shishliaeva-Matova (1942), Metcalf (1945), Boyd (1949), and others have described various anomalies in the salivary glands of different mosquitoes.

In connection with a detailed study on the development of the salivary glands in *Anopheles albimanus,* the author observed during routine dissections a remarkable diversity in the gross appearance of the adult salivary glands. While the salivary glands of mosquitoes are usually described typically as a pair of tri-lobed acini, numerous variations were found, particularly between the sexes. This note is a report on some of these observations.

In most instances, the glands in the female *A. albimanus* were found to be tri-lobed. The two lateral acini were similar in shape and size, each having a well-defined intra-acinar duct which lacked

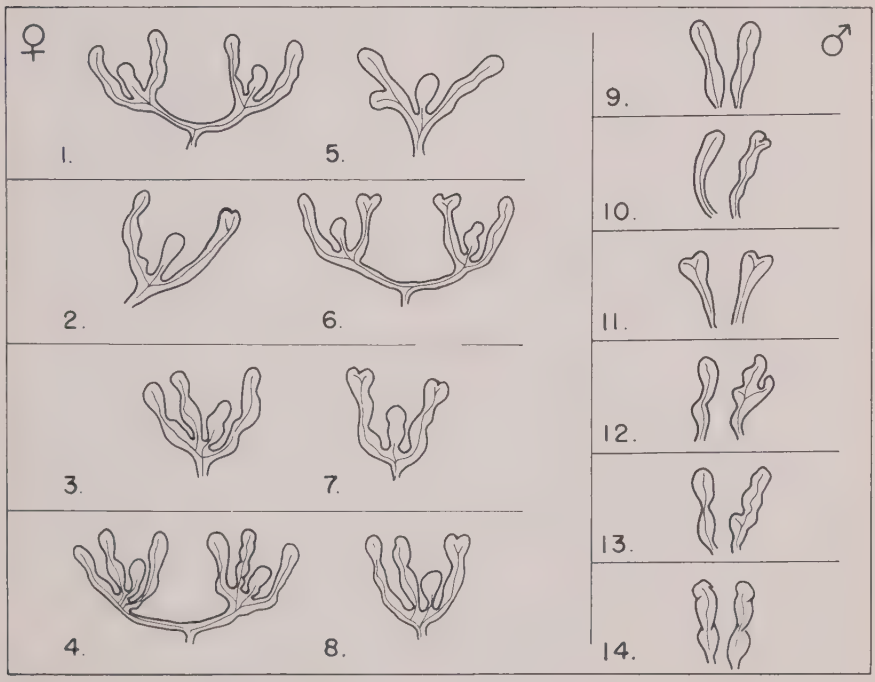

Plate I
(Diagrammatic)
Salivary glands present in the adult mosquito, *Anopheles albimanus.* Fig. 1 illustrates the paired tri-lobed glands which are typically present in the female and figs. 2–8 show various anomalies observed. Fig. 9 illustrates the mono-lobed glands most frequently found in the male and figs. 10–14 demonstrate the observed variations.

[1] From the U. S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, National Microbiological Institute, Bethesda 14, Maryland.

taenidial rings and which enlarged somewhat as it approached its termination. When a gland was quadri-lobed, one of the lateral acini branched to form two lobes. The middle acinus was characterized by being shorter and broader, having a pale yellow to greenish tinge, and a duct which was clearly visible in the proximal one-third of the gland and was not visible in the distal portion. It, too, lacked taenidial rings. In no instance was this middle lobe found to vary. The appearance of the secretory cells in all three acini differed greatly from time to time, probably depending upon differences in their activity. Their small, round nuclei were found at the base of the cells. Granules and clear droplets of various sizes were found in the cytoplasm. The three acini united at the salivary duct which contained a chitinous intima.

Of 100 adult females dissected, 69 specimens had glands that were normally trilobed (Plate 1, fig. 1), and 31 had glands that varied from this typical form. Among the latter, the following variations were observed: One of the lateral acini of one gland forked at distal end, 14 specimens (fig. 2); one gland composed of four lobes, 10 specimens (fig. 3); both glands composed of four lobes, two specimens (fig. 4); lateral acinus of one gland forked in middle, two specimens (fig. 5); each gland having one acinus forked distally, one specimen (fig. 6); both lateral acini of one gland forked distally, one specimen (fig. 7); and four acini present on one gland, one forked at distal end, one specimen (fig. 8).

In the male mosquito, the salivary glands were uniformly different from the female and were found to be mono-lobed, small, and not so well developed. These features suggest that the salivary glands in males are not so active as in females. Each gland was usually club-shaped and had an intra-acinar duct which extended nearly to the end of the acinus. Morphologically the intra-acinar duct resembled the salivary duct in that it appeared to be chitinized. Of 100 males dissected, 43 had glands that were mono-lobed, clavate, and symmetrical (fig. 9) and 57 had glands that were also essentially mono-lobed but differed in that one or both glands were sometimes forked, had one or two diverticula, or were spirally twisted. These variations in structure are listed as follows: Glands asymmetrical, (one gland forked distally, 31 specimens (fig. 10); glands symmetrical, both forked distally, 6 specimens (fig. 11); glands asymmetrical, one having two lateral diverticula, 9 specimens (fig. 12); glands asymmetrical, one having one lateral diverticulum, 9 specimens (fig. 13); and both glands symmetrical and spirally twisted, 2 specimens (fig. 14).

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CORRECTION

In the paper by Craig in Volume 15, No. 4 (December, 1955), an error in reproduction for printing makes the stated magnification of the illustrations of chorionic sculpturing of eggs of *Psorophora* incorrect. The correct magnification is 886× instead of 520×.—G. B. CRAIG, JR.

A NEW DISTRIBUTION RECORD FOR *CULEX SALINARIUS* COQ.: THE BERMUDA ISLANDS [1]

ROGER W. WILLIAMS [2]
School of Public Health and Administrative Medicine, Columbia University

Johnson (1913) and Ogilvie (1928) list the following mosquito species from the Bermudas: *Aedes argentus* (*Culex argenteus* Poiret, *Stegomyia calopus* Meig., *Stegomyia fasciata* Fab., *A. aegypti* L.), *A. sollicitans* Walk., *A. taeniorhynchus* Wied., and *Culex fatigans* Wied. (*C. quinquefasciatus* Say). In 1940, Waterston published a supplementary list of Bermuda insects which did not add to the list of mosquitoes.

On July 12, 1955 a study project was begun at Seymor pond, just west of Church Road, in Southampton parish. During the next week, mosquito adults were taken in *Culicoides* recovery cages placed in the thick seashore rush grass, *Sporobolus virginicus* (L.) Kunth., which grew profusely 2 or 3 feet out into the water. Larvae and pupae were dipped. Two mosquito species were recovered, *Aedes sollicitans,* which was in the minority, and a species of *Culex* other than *quinquefasciatus.* Study disclosed them to be *Culex salinarius* Coq.[3] The salinity of the water was determined with a special set of hydrometers for the determination of salt concentration in sea water and was found to be 13 parts of salt per 1,000 parts of water. The pH of the water, as determined by a Beckman pH meter, was 7.3 and the water temperature on July 13 was 27° C.

On July 28, 1955, *C. salinarius* was found again breeding profusely in the smaller of the two unnamed ponds on the Mid Ocean golf course in Hamilton parish near the entrance to the Castle Harbour Hotel, some 10 miles east of Seymor pond. The mosquito was again associated with a thick growth of *S. virginicus.* The salt content of the water was 10.9 parts per 1,000, the pH 6.7 and the water temperature 26° C.

It is well known by those who are familiar with the breeding habitats of this species that it may be found in either fresh or brackish water. However, the student who relies on the literature for this information may become confused, for Horsfall (1955) states that *C. salinarius* (according to Dyar and Knab) does not breed in brackish water and is strictly a fresh water mosquito. Horsfall does, however, mention elsewhere in his book that other investigators (e.g., Dorsey, 1944) found *salinarius* in brackish water. Carpenter and LaCasse (1955), in discussing the bionomics of this species, mention that it may be found in fresh and foul water but make no mention of brackish water, although Carpenter, *et al.* (1946) do state that it is found in brackish waters. Matheson (1944) states only that it breeds in marshy areas and rain barrels while Headlee (1945) on the other hand, mentions that the larvae occur in salt as well as in fresh water. The finding of *C. salinarius* in the brackish water ponds of the Bermuda islands re-emphasizes that this species may be found in brackish as well as in fresh water.

[1] Contribution No. 205 of the Bermuda Biological Station. This study was a result of a National Science Foundation grant-in-aid and a Childs Frick Fellowship from the Bermuda Biological Station for studies on the *Culicoides* of the Bermudas.

[2] I wish to express my sincere thanks to members of the staff of the Bermuda Agricultural Experiment Station, Gordon R. Groves, Director, Idwal Wyn Hughs, Plant Pathologist, J. Hubert Jones, Assistant Horticulturist and C. A. Baker, Horticulturist, for their kind assistance and identification of the seashore rush grass.

[3] Identification was confirmed by Dr. Alan Stone of the U. S. National Museum.

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OPERATIONAL AND SCIENTIFIC NOTES

GOOD DRAINAGE is one of the fundamentals of mosquito prevention. Thousands of miles of drainage ditches have been dug by the numerous mosquito control districts in this country and elsewhere. A lot of the ditching was done by hand and probably a lot more will be done that way. Power machinery and dynamite are widely used and have lightened the burden of the laborer. Another valuable aid is the light-weight servi-portable compressor with tools for breaking up clay and hardpan formations. This equipment can eliminate much of the pick, crowbar and mattock work so often required of labor.

The machine pictured here (fig. 1) can be wheeled out into swamps and marshes by two or three men. It has capacity to operate a 35 lb. clay spade, pavement breaker or rock drill. In clay and hardpan digging it does the work of two or three men.—R. L. Armstrong, Supt., E. Middlesex Mosquito Control Project, Cambridge, Mass.

FIGURE 1. Light weight compressor used to facilitate ditch digging.

The Skeeter, organ of the Virginia Mosquito Control Association, recently put forward two thoughtful suggestions which may be of use to others. One was that, in addition to the usual idea of trying to control borrow pits by persuading their builders to make them evenly sloped for good drainage, it is also possible to make them *deeper* and thus at least create an easily-controlled lake where one might otherwise have a difficult-to-control, trash-filled swamp.

The other idea in The Skeeter was for a most useful piece of equipment. Instead of carrying 55-gallon drums of insecticide, the Norfolk City Commission has made up two long, rectangular tanks, welded together out of 10 gauge steel, with baffle plates which also act as interior braces, and with flanges by which they are bolted snugly inside the body of a truck so that they run lengthwise. With dimensions of 84 x 17 x 10 inches, each holds approximately 60 gallons. They are fitted with filler caps on top and at the outer end have a 1¼ inch, quick-action, tank-truck valve which practically does away with leaks and drips and enables the men to fill their cans in less than one quarter of the former time. The 10 inch width of the tanks allows plenty of room in the middle of the truck for equipment and for the feet of the men who use the tanks for seats.

With regard to your article "An Applicator for Adding Chemicals to Flowing Water at Uniform Rates" by Gahan, Labrecque and Bowen in your Volume 15/3 of September last, it seems to me that there is a much simpler procedure available based upon a common laboratory device.

The tap and escape nozzle for the insecticide can be continuous in one piece. Into the vent at the side of the drum, which should be uppermost, is introduced a rubber bung through which passes a length of glass tubing sufficient to reach to within a few inches of the bottom of the drum. As the contents of the drum then flow out through the tap and orifice, a partial vacuum is formed in the air space above the liquid which is relieved from time to time by bubbles of air passing down the glass dip tube against the liquid pressure.

So long as the air which is entering the drum has to bubble through the liquid in this manner, the effective pressure of liquid at the orifice remains constant and is proportional to the difference in height between the bottom of the glass dip tube and the escape orifice. The principle is illustrated in the attached sketch.

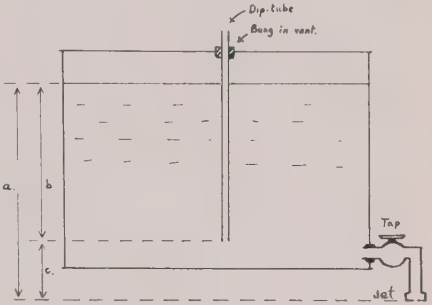

Fig. 1. a=actual height of liquid above jet.
b=head of liquid against which air must be drawn into air space.
c=effective head of liquid. This may be varied by raising or lowering the dip-tube in its bung.

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Rowland E. Dorer, Norfolk, Secretary-Treasurer

WORLD HEALTH DAY—7 APRIL 1956

"DESTROY DISEASE-CARRYING INSECTS!"

From a message from Dr. Fred L. Soper, Director of the Pan American Sanitary Bureau Regional Office of the World Health Organization: For ages man has accepted insects as an unavoidable curse and many people still think of them more as a nuisance than as one of man's deadliest enemies. Only within the past half century has their rôle as disease carriers been firmly established. Until recent years their control was costly, geographically restricted—and not too effective.

Today the picture has changed radically, with the development of residual insecticides such as DDT, which remains effective for at least six months. This has made possible the concept of *eradication*, one of the most important developments in public health history. . . .

The Pan American Sanitary Bureau has taken the lead in this Hemisphere in promoting eradication, rather than mere control, of those diseases, or insect vectors which are amenable to eradication. We have already seen most encouraging results: the urban yellow fever mosquito, once a grave threat in Brazil, has been eradicated from that largest of all countries in the Americas, and has either been eradicated or is in process of eradication in nearly every other country in the American Continent.

World attention is today focused on malaria, still one of the most widespread killers in many countries. The Pan American Sanitary Organization has launched, here in America, a Continent-wide program to wipe out malaria. We shall not be satisfied until it is accomplished.

Public understanding and cooperation are essential for success in the struggle to *destroy disease-carrying insects*. Everyone can take part in this great crusade by helping to increase awareness of the insect's rôle in the dissemination of disease.

JOSEPH A. LE PRINCE

As the *News* was going to press, word was received of the death of Colonel Joseph A. LePrince. The first information reached the *News* from Miss Annekay Tharp, Sponsor of the Howard-Krauss Society of the South Side High School, Memphis, Tennessee. We reprint, herewith, excerpts from the article which appeared in the "Triple S," (South Side High School paper), Vol. 33, for February 29, 1956.

"The Howard-Krauss Society deeply regrets the death of its founder, Colonel Joseph A. LePrince, on February 10, 1956, and also the death of its honorary member, Sir Malcolm Watson, on December 28, 1955.

"In 1936 Colonel LePrince organized the Howard-Krauss Society with Miss Annekay Tharp as sponsor. The club, under his direction, worked out an inexpensive type of malaria education for the masses. It used student talent for original posters, stories, radio programs, exhibits, skits and one-act plays, songs, essays, mosquito dances—all these before commercial artists and writers in America had entered the field of insect-transmitted disease control. . . .

"The T.V.A., when undertaking its malaria-education program, sent its director of malaria education to observe the Howard-Krauss Society at work. At the T.V.A.'s request all the society's original posters were sent to Chattanooga for study by T.V.A. personnel.

"Malaria specialists from Colombia, Peru, and Mexico came to the society to observe its methods.

"It was Colonel LePrince who interested Sir Malcolm Watson, then Dean of the Ross Institute of the London School of Tropical Medicine, in the Society."

ASSOCIATION NEWS

As We Go to Press We Are Able to Bring You, by Courtesy of Ted Raley and Dick Peters a full account of the meetings at Beaumont (Feb. 5, 6, 7, 8, 1956), although we regret to say that we must condense to fit the space available. Since the stories as to what happened at the banquet seem to vary a good deal, we are going to have to verify the facts before we can report them here.

All of the officers and all but three of the Regional Directors of the Association were present at the meetings. An excellent record.

Texas and Especially the Wonderful People of Jefferson and Galveston Counties apparently gave such a royal welcome to everyone that no one was able to recall later whether or not he had felt any aches and pains from sitting through the paper-reading sessions. These had to be undertaken in four-hour, no-recess segments in order to accommodate all the fine program which had been arranged by Fred Stutz and Ernestine Thurman and their committees. The paper-reading sessions were ably presided over by past-Presidents Dorer, Twinn and Rees and by Don Micks.

A buffet supper on the first night, two (or was it three) hospitality hours and a trip for the ladies on the Texas Company's yacht Ava, were only part of the entertainment, most of which was so lavish that it has left our correspondents speechless. But even the business meeting was well and enthusiastically attended.

The enthusiasm stemmed from the exceptionally favorable reports made from nearly every quarter on the condition of our Association. Lester Smith reported that the treasury showed an increase over last year nearly sufficient to cover the next four issues of the News. Art Lindquist reported on a budget which showed expenditures safely below the most conservative estimates of income. Francis Creadon's report on the sale of advertising space in *Mosquito News* was more than optimistic and was proof of the hard work which he has put into this exacting task since he took it over in mid-year. In the opinion of everyone he and Bill Bickley and Bob Vannote deserve great credit for this feat. Archie Hess reported that the Good Neighbor Club is now entirely current and has had an increase of 55 accounts for 1956. There is also a list of names which can take care of many more sponsors and every agency is urged to adopt at least one person or office on a permanent status. Miscellaneous Publications are all in the black, though there are still some of Numbers 2 and 3 available and their sale should be pushed.

Tommy Mulhern reported a challenging membership situation since the Association gained by 50 memberships this year but there were 134 drop-outs which were food for serious thought; an excess of 50 newcomers over the resignations does not allow for complacency, for there should be few or none dropping out. On the encouraging side, over 1,000 accounts were paid for 1955 and they are still coming in.

Bailey Pepper presented a completely revised Bylaws with the recommendation that they be reviewed and returned to his Committee by June. The final draft will then be presented to the Board of Directors and thence to the membership by mail prior to action at the next annual meeting. Johnny Mulrennan persuasively presented the case in favor of affirmative action by the Association on S 2870, a bill to promote research and development on mosquito control, urging that we make known our approval of further support for mosquito research whether or not we approved specific measures for implementing it. The following resolution on the subject was adopted at the session of February 7:

AMERICAN MOSQUITO CONTROL ASSOCIATION, INC.

February 7, 1956

Resolution

Whereas the American Mosquito Control Association, Inc., within the stated objectives of its Bylaws is dedicated to the furtherance of research on mosquitoes and their control, and whereas Senate Bill 2870 and corresponding House of Representatives Bills propose to make possible the conduct of greatly needed research, technical development, and control demonstrations on pest mosquitoes throughout the United States;

Now Therefore be it Resolved that this Association does herewith and hereby endorse and urgently urge passage of this significant legislation by the Congress of the United States, *providing that this Bill and the operational plan* pertaining to it contain or incorporate the following:

1. The U. S. Department of Agriculture engage in broadened aspects of research pertaining to mosquitoes in relation to agriculture.

2. The amount of funds allocated the U. S. Department of Agriculture be substantially increased to permit investigations on agricultural practices related to mosquito production.

3. At least one-half (50 per cent) of the funds derived be applied to research on mosquitoes to develop methods of control.

4. Where practical and desirable, existing research organizations and facilities be utilized to the maximum in effecting the operational plan.

Be it Further Resolved that copies of this resolution be transmitted to the United States House of Representatives; the United States Senate; the United States Department of Health, Education, and Welfare, and the United States Department of Agriculture.

Dr. Paul R. Mayer, Chairman of the Jefferson County Mosquito Control District presented a

check for $1200.00 to the Association, as his District's contribution toward the publication of the Proceedings. Material presented at the Beaumont meeting will be published in *Mosquito News* at the earliest possible date.

MO HIRST reported on the progress which has been made in preparing Bulletin No. 4, which will be entitled, "Organization for Mosquito Control." This herculean labor (and we *do* mean herculean) has made rapid progress indeed under the indefatigable MO. The first rough draft has been reviewed by each chapter chairman and has come back with revisions. The second draft is now being prepared from these revisions and, with the approval of the Executive Committee received at Beaumont, will shortly be ready for a final going over by the authors. Publication is now assured and this useful and long asked for compendium of practical field knowledge will soon be ready for use.

NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION

NEW BRUNSWICK, N. J.

The

New Jersey Mosquito Extermination Association

Encourages and Supports

Mosquito Control

Printed "Proceedings" of 42 Annual Meetings are for sale.

NEWS AND NOTES

Everyone Knows by Now, and can find listed elsewhere in this issue, that Fred Stutz is our new President, Art Lindquist the President-elect, and Mo Hirst, Vice-president, but does everyone know that the banquet was enlivened in truly Texan manner by no speeches and by the substitution therefor of 35—Count 'em—35 Melody Maids? All *mighty* pretty, too, we hear and mighty purty singers as well. Led by Mrs. Milam of Beaumont, an ex-Navy wife, the Melody Maids, who have been just about all over the world with their melodies, paid especial attention, we hear, to Rollie Dorer, Lester Smith and Ted Raley, whose birthday it was. Happy Birthday last month, Ted!

Speaking of Rollie Dorer, The Virginia Mosquito Control Association, that active organization of which he is secretary and treasurer, had a stimulating and enjoyable annual meeting on 23 February at Franklin, Va. Among the speakers were such well-known and thought-provoking authorities as Clyde F. Fehn of the USPHS at Savannah, Ga., W. C. McDuffie of the USDA, Bill Bickley of the University of Maryland, Bob Vannote of New Jersey, Harold Russell of the Fifth Naval District, and other local mosquito control experts of wide experience. Franklin, Virginia, is famous for its culinary abilities even in that state of culinary artists.

George J. Burton, with Foa in Nepal, who may be addressed as Lt. Col. through APO 74, Box N, % Postmaster, San Francisco, writes that all of the Nepali officials with whom he works speak English, as do many other residents whom he finds to be "exceedingly ready, willing and able." George is conducting a pre-treatment survey before starting spraying with dieldrin, which is also a post-treatment survey for the three years of DDT spraying now concluded. His findings ought to be of as much interest as were the ones previously reported which he made in Liberia, and we look forward to further bulletins.

E. Chester Robinson, of the Alameda County Mosquito Abatement District, reports that although the phenomenal floods, which are causing so much anguished anticipation of mosquito troubles to come, did not fail to hit his district to some extent, the men have been busily overhauling, cleaning and painting equipment, repairing and replacing tidegates and maintaining ditches, heartened by the knowledge that service requests dropped to zero in December; and in January, though they came back up, it was only to report gnats or anticipated mosquito sources and a solitary instance of *Culiseta inornata*.

Milt Buehler's Third Annual Report of the Lane County (Oregon) Mosquito Control Program has just come to hand, and it is something that every mosquito abatement man ought to peruse and then think about emulating. The Lane County Mosquito Control Program was established on 1 April 1953, and we will venture to assume that Milt's constituents are better informed already than many people in districts that have been longer established. His booklet not only tells his customers what his district is doing about mosquitoes but gives a concise and understandable summary of the insects themselves, the insecticides and mosquito control problems as they occur and are recognized elsewhere. Printed in an attractive, pocket-size format, his pamphlet has everything to recommend it and we urge mosquito workers everywhere to study this useful example of good public relations.

The California Mosquito Control Association Held its Annual Meeting on 16, 17 and 18 January in the Hotel Stockton, Stockton, California. Despite the flood conditions which had necessitated a last-minute switch from Marysville, the meetings were well attended, some of the participants coming from Oregon, Nevada, and Utah, as well as from all parts of the Golden State. Many fact-filled and hard-punching papers were presented by University, State and Federal experts, as well as those from mosquito abatement districts. In a year distinguished by speechless and epicurean banquets, California managed to hold its own. Don Murray was elected President for 1956, Howard Greenfield, Vice-president and Ed Washburn was retained as the hard-working and dependable secretary. He, Ted Raley and Lester Smith, among others, ought to be warnings to any of our youth who tend to be hardworking and dependable. It don't pay, boys. You get elected to things with *work* in them.

Helen Louise Durkee Forwards Some Letters from Ralph Barr which are mighty interesting. "I hope more people will send me *Culex pipiens* material," he writes, "so it would be useful to have my change of address published." (It's Department of Entomology, University of Kansas.) "Incidentally, the *Culex pipiens* situation appears to be quite different in Sacramento County from that in other areas of the country. In other areas (Salt Lake City, St. Louis, parts of Kansas) *pipiens* and *fatigans* appear to remain relatively distinct, although hybridization does seem to occur. In Sacramento, on the other hand, the population appears to be thoroughly mixed. . . . At the present time, we have two projects going here, one on tularemia (in ticks) and one on *Culex pipiens*. I instituted a program of light trapping last summer to find out what mosquitoes we had, and when and where we had

them. We have already found some interesting things and I hope we will be able to expand the program next year. We have found some nice populations of quads, punks, *Culex pipiens, tarsalis,* and *territans, Aedes triseriatus* and a few others."

HELEN LOUISE also SAYS ABOUT HERSELF THAT, "The rains, although not causing damage to our house, certainly discombobulated us for a while and emergency conditions prevailed on Mt. Diablo and KOVR. Water went through houses at the end of our avenue as if it were swirling in its own channel . . . just about a foot or two deep, but that's enough when it's your own house, isn't it?"

ED SMITH IS SOON TO BE WITH FOA AND EN ROUTE TO DJAKARTA WHERE PROF. C. Y. CHOW is already located. Prof. Chow's new address is WHO Entomologist, No. 3, Teuku Umar, Djakarta, Indonesia. He writes us that in December he attended the WHO Filariasis Study Group in Kuala Lumpur, Malaya, which lasted for 10 days, and where he saw, among other notables, Prof. Galliard of Paris, Prof. Kessel of the University of California, Dr. Raghavan of India, Dr. Dy, of Manila, and Dr. Giaquinto of WHO.

THE ANNUAL MEETING OF THE NORTHEASTERN MOSQUITO CONTROL ASSOCIATION was held on 19 and 20 January at the State Experiment Station, Waltham, Mass. The Association is also sponsoring another technical training course, which is planned tentatively for March 23 and 24 at the University of Rhode Island and for March 26 and 27 at the University of Massachusetts at Amherst. The CDC Training Section of the USPHS at Atlanta, Ga., is also joining the two Universities and the Association in their sponsorship.

A SIMILAR TRAINING COURSE WAS HELD IN NOVEMBER AT THE VIRGINIA POLYTECHNIC INSTITUTE, at which Rollie Dorer was one of the lecturers. Persons attended from not only Virginia but also West Virginia, Tennessee, Maryland, North and South Carolinas, New York, New Jersey, Ohio, Georgia and the District of Columbia.

ONE OF OUR GOOD NEIGHBORS, S. PRASANNA KUMARA GUPTA, of the India News Service in Bangalore, writes that he has had word from Uncle Harry, in response to our query of September. He sends us a copy of Harry's letter, which bore tidings similar to those in the note we received ourselves. It should be a very heartening matter to us all, and cause us to support our Good Neighbor Club with renewed enthusiasm, to realize that in a very real way our *Mosquito News* is helping to "enlighten the world." Mr. Gupta comments in particular on the fact that a paper read before our Association was reported in the Indian Press, augmenting the interest in mosquito control and strengthening the hands of local workers in the field.

FRED H. STUTZ, new President of AMCA, SHOULD LEAD OFF OUR WHO'S WHO IN AMCA this month but, like his predecessor in office, he was so modest in filling out his form that all we know about him is what everyone knows already: that he is the able director of the Dade County Anti-Mosquito District, a founder and pillar of AMCA and will be host to the next annual meeting. If we can pry it out of Fred, we'll bring you news of his early life at a later date.

WE HAVE ALWAYS SUPPOSED THAT J. MELTON WILLIAMS WAS BORN IN FLORIDA and he doesn't deny it on his Who's Who form. At any rate he went to High School in Palmetto and attended the University of Florida as well as Georgetown University in Washington, D. C., and North Carolina State in Raleigh. He was in public health work from 1936 to 1941 when he started a four year hitch with Malaria Control Team No. 39, of the U. S. Navy. Since 1945 he has been Director of the Sarasota County mosquito control work and will be another of our hosts next year. His hobbies are hunting and fishing, as whose wouldn't be, in Florida?

ANOTHER HOST FOR NEXT YEAR IS OUR REDOUBTABLE HOST OF A FEW YEARS AGO whose birthplace came as quite a shock, used as we were to associating him with Florida. Instead, he was born in Wisconsin, though he asserts he has lived in Florida since 1925, which is practically as long as anyone has. He studied mosquito control under George Bradley and Barney Travis at New Smyrna Beach and received his certificate for extension work in engineering and surveying at the University of Florida. He is a Past Exalted Ruler of the B.P.O.E. and an honorary life member, and his professional connection is as Director of the East Volusia County Anti-Mosquito District. Of course . . . SAM MINNICH! (His hobby is Horses; equitation, that is.)

WE PROMISED TO TELL YOU ABOUT BOB PETERS SOME TIME BACK and we have finally got it out of him. These Peters boys are sure modest. Bob, like Dick, was born in Oakland, California, in 1915, two of a family of four children. After his collegiate training at Polytechnic Junior College and the University of California (where he also took later Public Health work), Bob entered into public service, where he has remained for the past 17 years. Four of this was as a Marine Captain, as a pilot from 1942 to 1946. Flying is still a hobby, along with cartooning and other art work. He is Director of the Northern San Joaquin County Mosquito Abatement District which "has emphasized mosquito abatement through source reduction since its origin in 1945." It covers an area of 409 square miles; effectively, too.

THOSE WHO ARE OR WERE IN THE MILITARY MOSQUITO CONTROL PROGRAMS HAVE what seems to us a well-justified pride in the feeling that their

efforts have, in addition to abating mosquitoes around the world, added immeasurably to the public knowledge and support of mosquito control programs. AMCA members, military and civilian, head up the extensive Armed Forces insect control activities, and we present some of them to you:

Ralph Bunn, Lt. Col. and Chief of the Entomology Section, Preventive Medicine Division, Office of the Surgeon General, U. S. Army, spent the first 10 years of his entomological career with the United States Department of Agriculture, from which he went to the Army Sanitary Corps as an entomologist in 1941. At the end of the war, he became assistant chief of the Insect and Rodent Control Section of the Office of the Chief of Engineers of the Army. In 1947 he was recalled by the Medical Service to active duty and has seen service in Europe twice in addition to having had a previous tour in his present position. His hobbies are photography, boating and fishing and other "sedentary sports," he says, and also claims he hates desk work. Unfortunately for him, he's so good at it, as we all know, that no one ever wants him to leave and they always ask for him back, so we guess he's irretrievably typed.

George L. Hutton, civilian head of the Pest Control Section of the Navy's Bureau of Yards and Docks, has also had wide experience in both the military and civilian phases of the Armed Forces mosquito control work. He graduated from Purdue in 1939 and was an Army entomologist, "grades Pvt. through Major," from 1941 to 1946, being in charge of the field operations of the "Cordon Sanitaire" of the Rhine River with the 12th Army Group. He was Assistant Chief of the Entomology Section of the Office of the Chief of Engineers of the Army and later became Entomologist of the Engineer Division of the Headquarters, European Command, from 1949 to 1951. Returning to the United States in 1952, George spent a year as Superintendant and Entomologist of the busy and successful Toledo Area Sanitary District, but was lured back into military environs to head up the work for the civil engineers in the Navy, in 1953. We could tell you lots of creditable (and truthful) things about George but buttering up the boss wouldn't do us any good, so we won't.

Dr. Kenneth L. Knight, Cdr. and Chief of the entomology branch of the Division of Preventive Medicine in the Navy's Bureau of Medicine and Surgery, is so well known for his mosquito work that we should hesitate to say any more about him except for the fact that he is so modest that very few of us know all the things he has done. Ken was born in 1915 in Illinois, where he eventually went to school and emerged from the University with his PhD in 1941. He entered the Navy Medical Service Corps the same year and was Area Entomologist in the South Pacific in 1942 and 1943, with some 34 entomologists working under his direction and coördination. He trained the Naval Medical Research Unit No. 2, which went back to the Pacific in 1944 and there Ken did extensive taxonomic work in the Solomons, New Hebrides, New Guinea and the Philippines. With Dr. Roseboom, he sorted out the *punctulatus* complex, vectors in the South Pacific and in the Philippines; he added 40 species to the Culicines known to occur there, of which 20 were new species. He has since spent time at the British Museum, in the Arctic, in Cairo, Egypt, and in Jacksonville, Fla. He says his hobby is "mosquitoes" and this must be right for he spends most of his free time, together with Alan Stone, on a catalogue of the mosquitoes of the world. (The last such catalogue was done in 1932, since which time there has been a 30% increase in known species.) Ken is married and he and his wife have 5 children whom, we may add, Ken doesn't *entirely* neglect for his mosquitoes. (We dug this all out ourselves, though, and if we left anything out it's Ken's own fault; all *he* gave was his name and address.)

W. D. Reed, a retired Lt. Colonel in the Army Medical Service Corps, has been military and civilian head of the Entomology Section of the Office of the Chief of Engineers, U. S. Army, since 1945. At that time Doyle was a Lieutenant, whom one General characterized as having "less rank and more authority than anyone in the U. S. Army." Doyle was born in Eupora, Mississippi in 1897, and graduated from Mississippi A and M in 1922, following which he had two years' studies at Cornell. He was a professor at Clemson College for three years, after which he came to the U. S. Department of Agriculture, working first with Dried Fruit Insects, in California, and then as Head of the Tobacco Insects Laboratory in Virginia. He also went into the Army the hard way, starting out in the ranks and digging mosquito ditches, he says, long before he directed them. Well, there's no better way to learn, we always say. Doyle has been principally responsible for the early establishment of sound insect control programs in the engineer sections of the Armed Forces and, as may be noted, has many "graduates" among the military establishments.

Rufus Vincent, Chief of the Entomology Section of the Directorate of Facilities Support, of the Headquarters of the U. S. Air Forces, is another of the "gradautes" mentioned above. Born and brought up in Maryland, Vince graduated from the University of Maryland and got his MS there in 1948. Leaving the position as Assistant Professor of Entomology which he had held there since 1939, he went into the Army Sanitary Corps as a Captain in 1942 and served in Florida, England, France, Germany and Italy. Returning to the University in 1946, he was lured away in 1948 by the siren call of the Pacific Islands, where he was entomologist for the Marianas-Bonins Command through 1951. From 1951 to 1954 he was Assistant Chief, of the Entomology Section, Office of the Chief of Engineers, U. S. Army, leaving in 1954 to establish his present position with the Air Forces. His wide experi-

ence in mosquito control around the world stands him in good stead in this and he needs it in his efforts to "ground" the mosquitoes so that the fly boys can "keep 'em flying."

FRANKLIN C. WRAY REPORTS, JUST AS WE GO TO PRESS, THAT THE ILLINOIS MOSQUITO CONTROL ASSOCIATION held its second annual meeting on 7 and 8 March, at the University of Illinois, Urbana, Illinois. He promises details for a later issue. He also reports that another mosquito abatement district has been organized in Illinois and will begin active field operations this year. "The Wheaton, Illinois, District covers approximately 15 miles," he says, "And adjoins the western boundary of the Glen Ellyn District in DuPage County, 16 miles west of Chicago."

THE GOVERNMENT OF INDIA issued a six annas postage stamp during 1955 in recognition of the Indian malaria control program. This brown stamp has the inscription "Malaria Control" on top and depicts two scenes. On the left side is shown the impoverished conditions which may exist in malarious areas. On the right side is shown a modern development made possible by successful anti-malarial operations. In the center is the caduceus, symbolizing the medical profession.

So far as is known, this is the first time that malaria control activities have been used as the theme for a postage stamp. It is understandable why India, a country formerly having more than 1,000,000 deaths annually from this disease and now conducting the largest and one of the most successful malaria control campaigns in world history, has honored malaria control in this manner.—Donald R. Johnson, Entomologist, Division of International Health, Public Health Service, Washington 25, D. C.

CLARENCE L. BRADLEY, SUPERVISING SANITARIAN, Health Department, City of Fargo, writes that he is attending the V Inter-American Congress of Sanitary Engineering at Lima, Peru, and is submitting a paper entitled "Fargo's Insect and Rodent Control Program." The Congress convenes from March 19 through March 25, 1956.

HARRY STAGE submits the following information in a letter from Vietnam:

The four Southeast Asian countries of Laos, Cambodia, Thailand and Vietnam sent delegates to the first coordination Conference on Malaria to be held in this region Jan. 10–12, 1956. The meeting was sponsored by WHO and Dr. Francisco Dy was Secretary. The chairmanship was rotated among the delegates of the four countries. Harry H. Stage attended and was responsible for introducing a resolution, which was approved, to set up a Malaria Coordination Board composed of the Heads of the Malaria Control Services of the four countries. This board will meet annually for the purpose of coordinating their programs and increase their effectiveness.

HARRY hopes to see several members of the American Mosquito Control Association at the Tenth International Congress on Entomology in Montreal come mid-August. He is on the program to give a paper on "Malaria Control Problems in Vietnam." He is meeting Mrs. Stage in Istanbul in early June and after visiting the Fred Bishopps in Cairo, the Mediterranean area, and Lapland, will return via the S.S. "Queen Mary" in time to go up to Montreal. He says he's a-raring to get into *Mosquito News* activities again.

UTAH MOSQUITO ABATEMENT ASSOCIATION

Districts: Box Elder County, Davis County, Magna, Salt Lake City, South Salt Lake County, Weber County

Sixty per cent of the people in the state of Utah are now living within the boundaries of organized mosquito abatement districts.

The next annual meeting will be held at Midvale, Utah, March 16th and 17th, 1956. Proceedings will be published.

REVIEWS AND ABSTRACTS

Man's Mastery of Malaria. By Paul F. Russell, M.D., M.P.H., Division of Medicine and Public Health, Rockefeller Foundation. 308 pp., 19 figures. London, New York, Toronto: Oxford University Press. 1955. This book consists of a series of lectures on malaria, published under the title, "Man's Mastery of Malaria." The lectures are grouped in five sections: I, The Unfolding of Malaria Aetiology; II, The Unravelling of Malaria Therapy; III, The Development of Malaria Prophylaxis; IV, Some International Aspects of Malaria; and V, Malaria and Society. More than 500 selected references from the enormous literature on this subject are included.

This book tells the story of how man has at last mastered malaria. The story is told by reviewing the developments in knowledge of the disease and its control from the earliest recorded history to the present time. In the preface the author indicates that the title may seem misleading since malaria is still a serious problem in many areas of the world, but he emphasizes the fact that malaria, after centuries of effort, is now universally controllable, and thus man is at last the master. Dr. Russell points out that the disease is now retreating with spectacular speed and says, "While keeping in mind the realities one can nevertheless be confident that malaria is well on its way towards oblivion."

The book is written in an easy style which makes it highly readable and it can be recommended as an excellent, though brief, historical account of man's experiences leading from "mystery to mastery" of malaria.—Stanley J. Carpenter, Walter Reed Army Medical Center, Washington 12, D. C.

Organic Insecticides, Their Chemistry and Mode of Action. By Robert L. Metcalf. Interscience Publishers, Inc., N. Y., 392 pp., 1955. This well-documented book summarizes our knowledge up to June, 1955, concerning the chemistry and modes of action of nicotine and related compounds, rotenoids, pyrethroids, organic thiocyanates, dinitrophenols, DDT, 9 different acaricides, BHC, cyclodiene insecticides, organic phosphates, carbamates, and various miscellaneous insecticides. A chapter each is devoted to the joint action of insecticides and to insecticide resistance.

There are 1,223 references (titles not given), 70 tables, numerous formulas and equations, and 7 figures. The index is not as complete as one might wish: most of the several hundred species mentioned throughout the book are not indexed (e.g., different species of *Anopheles, Calliphora, Loxostege, Oncopeltus* and *Porthetria*). Relatively few and innocuous typographical errors are present. The book is well-bound and clearly printed.

Very little information about mosquitoes is given in this book, but it will be invaluable to entomologists, physiologists, and chemists interested in insect control for it is written with clarity, gives well-authenticated details and presents conflicting theories impartially. This monograph should stimulate ". . . the logical and orderly development of the subject of insect toxicology, so that the practical achievements of the future will result from the application of basic concepts rather than from laborious empirical sorting."—Jack Colvard Jones, Nat. Inst. Health, Bethesda, Md.

Fifty Years of Malaria Control in the Panama Area. By E. J. Dehné. Amer. J. trop. Med. Hyg. 4(5):800–811. 22 refs. 1955. The efforts to control malaria in the vicinity of the Panama Canal during the half century were progressively more successful as new methods developed. Sanitary engineering works of a permanent type have controlled mosquito breeding in the vicinity of communities in the Canal Zone. A battery of chemicals are in use for destroying mosquitoes in all phases of their life cycle and new drugs for effectively attacking the malaria parasite in the human carrier and patient are now at our disposal.

Malaria has been reduced to an uncommon disease in the Canal Zone, and urban communities of the Republic of Panama enjoy a considerable degree of freedom from infection, but rural communities and hamlets continue to lose much of their economic production potential due to malaria. Aggressive antimalaria programs temporarily reduce the disease but eradication has not been achieved in Panama. Temporary inactivity of malaria in a community may delude the inhabitants but the disease is unlikely to remain quiescent for long. Continuing and unremittent application of control measures by the individual and the community aimed at reducing the vector and treating the carriers is the solution to this problem in the Panama area. Once initiated, the control should be integrated into the community functions and become a permanent part of the community routine.—Author's summary.

A Mobile Laboratory for Field Research in Entomology and Insect Pathology. By R. B. Baird and C. F. Nicholls. Research Notes Series Entomology E-10. 7 pp. 4 photos, 4 drawings. 1955. Dept. Agric. Science Service, Entomology Division, Ottawa, Canada. The basic unit was designed to satisfy the needs of two research workers required to remain in the field for extended periods. It can function as a temporary field laboratory for additional workers if extra living accommodation is provided by a tent. The basic unit can be modified for use in a wide variety of field programs by this addition of the necessary specialized equipment. . . . The labora-

tory was built and equipped, excluding the specialized scientific equipment, for approximately $6,500. Further construction details may be obtained from the authors.—Excerpts from author's discussion.

The unit is very compact. The outside dimensions are: overall length, 21 feet, 5 inches; width, 90 inches; and overhead clearance, 114 inches. The inside dimensions of the laboratory and living space are: length (not including the cab portion), 133 inches; height, 76 inches; and width of aisle between the benches, 37 inches. The gross weight of the vehicle is under five tons. The compact size permits the use of the vehicle over any road or terrain where a car can be used. . . . The laboratory is equipped with electricity, liquid propane gas, and water. . . . The laboratory being equipped for studying microorganisms, it is provided with such equipment as microscopes, a potentiometer, a hygrothermograph, a small incubator, and a pressure cooker and a temperature-controlled oven for steam and dry sterilization respectively. The two-cubic-foot, temperature-controlled incubator is heated by a single light bulb and operates from room temperature to 36° C. It can be operated from either six-volt or 110-volt electricity. Materials such as culture tubes, flasks, reagent bottles, and culture media are kept in the specially fitted wall cupboards.—Excerpts from text.

ACTIVITIES OF THE TRINIDAD REGIONAL VIRUS LABORATORY IN 1953 AND 1954 WITH SPECIAL REFERENCE TO THE YELLOW FEVER OUTBREAK IN TRINIDAD, B. W. I. By W. G. Downs, T. H. G. Aitken and C. R. Anderson. Amer. J. trop. Med. Hyg. 4(5):837–843. 8 refs. 1955. Serological surveys of Trinidad residents by the Trinidad Regional Virus Laboratory demonstrated yellow fever immunes in 8 individuals 15–19 years of age, and in a high proportion of older individuals. Yellow fever virus was isolated from a human case in April 1954. Subsequently virus isolations have been made from 13 other human cases, 7 red howler (*Alouatta*) monkeys which were brought in dead, 21 pools of *Haemagogus* mosquitoes, and 1 pool of mixed mosquitoes—a total of 43 virus isolations. Yellow fever virus was repeatedly recovered from *Haemagogus* mosquitoes captured at ground level.—Author's summary.

The repeated isolations of virus from mosquitoes lend heavy support to the *Haemagogue*-monkey cycle in yellow fever transmission in the New World. An additional point of great interest is the relative ease with which *Haemagogus* are captured on the ground in Trinidad, and the frequent recovery of yellow fever virus from those ground-captured *Haemagogus*. . . . *Haemagogus s. spegazzinii* is the only species of the genus that we have recognized thus far in the island. While not to be considered as a domestic species, during its peak months of August and September this mosquito may be a pest inside houses near the forest, entering freely and biting viciously in the daytime. . . . It has been observed that captures of this mosquito in the forest canopy exceed numerically those made at ground level, as has been shown in many regions. However, it is not at all uncommon to collect *Haemagogus* biting at ground level in the forest—particularly on sunny days—at a roadside, or in a clearing. Captures may run as high as several hundred in a few hours' collecting at ground level under favorable circumstances. The repeated isolations of yellow fever virus from *Haemagogus* biting at ground level point out that these mosquitoes in Trinidad must be feared by anyone entering the forest or even parking at the roadside.

The Health Department of the Government of Trinidad and Tobago started an intensive anti-*Aedes* campaign in June 1954, and an island-wide immunization program in July 1954. By the time the epidemic was at its apparent peak, during August and September 1954, a large proportion of the residents in the forested areas of the island had received immunizations with 17D vaccine, and extensive *Aedes aegypti* control had been accomplished in the urban areas. Before the Health Department program had started, a large part of the island population had never been immunized against yellow fever (except for the considerable immunization of older inhabitants as a result of earlier epidemics) and *Aedes aegypti* house indices were high, both in urban and rural areas. The stage was set for an explosive outbreak of yellow fever. Whether the Health Department's prompt and vigorous campaign averted a serious epidemic will never be known. But the fortuitous finding of an early case in April, 1954, permitting a control campaign to be well under way before the epidemic peak was reached, may well have averted a major outbreak. —Excerpts from the text.

UEBER DIE ZUSAMMENHANGE ZWISCHEN VERBREITUNG UND UEBERWINTERUNGSMODUS BEI DER STECHMUCKE *Aedes* (*Ochlerotatus*) *rusticus* ROSSI. (BEITRAGE ZUR KENNTNIS DER CULICIDAE III). E. Kirchberg and K. Petri. Zeitschr. fur angewandte Zool. No. 1 (Reprint):81–94. 1955. *Aedes rusticus*, unlike other northern and far-northern European *Aedes*, normally hibernates in the last (?) larval stadium ("completely developed larvae") rather than in the egg stage.

This paper is concerned with relating the distribution of *Aedes rusticus* in its "Atlanto-Mediterranean" range with the degree of severity of the winters. The authors find that *rusticus* larvae are "greatly weakened" (40–70 percent mortality) when their breeding places are covered with a layer of ice (thickness not given), and are killed when the larval breeding areas are frozen solid to the bottom.

The *rusticus* species finds its optimum conditions during "mild" winters west and south of the —1° C. January isotherm where ice does not cover larval breeding sites. The authors point out the probability that in addition to the temperature

other factors doubtless limit the range of *Ae. rusticus,* e.g., nature of the soil, amount and seasonal distribution of rainfall, humidity, etc. The collection of these types of data was not undertaken in the present report.

Many intriguing questions arise from a study such as this one, e.g., does the depth of the ice layer have a relationship to larval mortality excluding solid frozen states.—Jack Colvard Jones, National Institutes of Health, Bethesda 14, Md.

Inactivacion de Los Depósitos de DDT en Las Superficies de Barro. By E. Bordas, W. G. Downs and L. Navarro. Bol. Oficina Sanitaria Panamericana 37(2):167–186. 17 refs. 1954. The problem of the inactivation of DDT deposits on dry and mud surfaces is presented and its causes outlined. The phenomenon is found to be due to adsorption of the DDT crystals present on the surface; this adsorption appears to be the initial step in the catalytic decomposition of DDT by the iron oxides present in soils, since there is a direct relation between the amount of oxides present and their capacity to inactivate DDT deposits.

The DDT inactivating capacity of soils can be determined by testing them for catalytic activity in the thermal decomposition of DDT. The adsorption of DDT by soils is influenced by environmental relative humdity. Inactivated deposits may be reactivated by increase of the atmospheric humidity.

Several substances proposed for the protection of the DDT deposit from inactivation were tested without success. Reference is made, however, to the encouraging findings of some other workers. Limewashing is recommended for the protection of DDT deposits.—Authors' summary.

Malaria in the Torres Straits Islands. Mackerras, M. J. and Sandars, D. F. South Pacific Commission Technical Paper No. 68. Noumea, New Caledonia. 1954. 27 pp. 7 tables, 2 maps, 8 text photos, 18 refs. Malaria surveys were made in the Torres Straits Islands and adjacent mainland of Australia in 1949, 1952, and 1953. The eastern islands were found to be normally free from malaria, but an epidemic of pure *P. falciparum* infection occurred on Murray and Darnley Islands in 1952. By 1953, the infection had disappeared from Murray, but had persisted on Darnley Island. The natives showed considerable racial tolerance to their infection.

In the western islands, a few cases of malignant tertian malaria were found on Boigu and Dauan close to the New Guinea coast. Saibai, which is also very close to New Guinea, was remarkably free from infection. Two quartan infections were found at Kubin on Moa Island. *P. vivax* was seen only once, in a native of Saibai living on Cape York.

No malaria was found in Australian natives in settlements on the mainland near Cape York, nor in other native settlements in the Gulf of Carpentaria. There is no evidence that malaria is now endemic anywhere on the mainland of Australia.—Authors' summary.

Anopheline mosquitoes are widely distributed, and it is a real puzzle why malaria is not prevalent on many of these islands, and, in particular, why Boigu and Saibai are not hyper-endemic areas.

Investigations on Murray Island in 1952. . . . The mosquitoes concerned: The only anopheline found on the island was *Anopheles farauti,* which was breeding in freshwater pools thoroughout the whole length of Bruce Brook in June, 1952. A small number of adults of this species was taken at night biting man. Measures taken to reduce the mosquito population consisted of clearing the mouth of Bruce Brook to allow seawater to flow in freely, and in spraying the creek with diesel oil. Later a DDT preparation was used for spraying houses and breeding places.

Investigations on Darnley Island in 1952. . . . the mosquitoes concerned: The only anopheline taken was *Anopheles farauti,* which was found breeding in abandoned 4-gallon drums half-filled with debris and rainwater. It was stated by the natives that mosquitoes had been particularly abundant at the end of the wet season. All natural breeding places adjacent to the settlement had been sprayed heavily with diesel oil before our arrival. No adults were taken, although searched for in several localities using natives as bait.

Nepean Island. . . . Only one species of mosquito was found on Nepean Island, *Aedes scutellaris scutellaris* (Walker), which was breeding in domestic water containers and clam shells.

York Island. . . . the only mosquito so far recorded from the island is *Aedes scutellaris scutellaris,* which was found breeding in 44-gallon drums of rainwater.

Coconut Island. . . . No mosquitoes have been recorded from this island, but survey visits have been very brief and without adequate opportunity to search for them.

Yam Island. . . . No anopheline mosquitoes were found.

The Anopheline Fauna of the Mid-Western Islands. Adult anophelines were not abundant during the time of our visit (April–May). Two species were found on Badu, *Anopheles novaguinensis* Venhuis and *A. meraukensis* Venhuis. The former was the only species taken on Mabuiag. On Moa, three species were taken, *A. bancrofti* Giles, *A. meraukensis* and *A. farauti.* The last named, which is an important vector in New Guinea and on the mainland of Australia, was only found at Gerain. However, it is probably far more widespread during the wet season, and there seems no good reason why it should not eventually be recorded from Badu and possibly also from Mabuiag. Although *A. bancrofti* was breeding freely in a large, fresh-water swamp close to the village at St. Paul's, it did not seem to be a troublesome species, and was

only rarely taken biting man during our stay there.

THE ANOPHELINE FAUNA OF THE FAR-WESTERN ISLANDS. This was in marked contrast to that of other islands visited. On Boigu and Saibai, we were assailed from dusk throughout the night by hordes of *Anopheles farauti* and *A. amictus hilli* Woodhill and Lee. Both breed readily in brackish water, and their breeding grounds on these two islands were extensive. *A. bancrofti* was also found on Saibai. On Dauan, which was only visited for a couple of hours one afternoon, *A. farauti* was found breeding in a fresh water pool.

THURSDAY ISLAND. . . . The natives concerned were living near a small creek on the western side of the island. Two species of anophelines were taken breeding in this creek, namely *Anopheles annulipes* Walker, and *A. meraukensis*. Either could have acted as the vector." On the adjacent Horn Island, two other species were found, *A. powelli* Lee and *A. novaguinensis*, which may well occur on Thursday Island, too.

THE ANOPHELINE FAUNA OF CAPE YORK PENINSULA. . . . It supports a rich mosquito fauna, including six species of anophelines. These are: *A. powelli, A. bancrofti, A. annulipes, A. farauti, A. novaguinensis* and *A. meraukensis*. A few adults of *A. powelli, A. bancrofti* and *A. novaguinensis* were taken biting horses at dusk near a creek at Bamaga, but they were not obtrusive on man in-doors or out-of-doors, either in July, 1952, or in May, 1953.—Excerpts from text and discussion of authors, Queensland Institute of Medical Research and Department of Social and Tropical Medicine, University of Queensland, Australia.

CALIFORNIA MOSQUITO CONTROL ASSOCIATION, INC.

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Plant Pest Control Branch, Agricultural Research Service, United States Department of Agriculture

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